

September 27, 2019

VIA First Class Mail

Scott Scheele
Chief, Telecommunications and Broadband Section
Antitrust Division, Department of Justice
450 Fifth Street NW, Suite 7000
Washington, DC 20530

Re: Comments of the International Center for Law & Economics, United States et al. v. Deutsche Telekom AG et al.; Proposed Final Judgment and Competitive Impact Statement, 84 Fed. Reg. 39862 (Aug. 12, 2019)

Dear Mr. Scheele:

We are filing this Tunney Act comment regarding the Proposed Final Judgment in the above captioned case under review in the United States District Court for the District of Columbia.

The central question of a merger review is the likely effect that the transaction will have on consumers. The DOJ's complaint in this case is built upon the allegation that the proposed transaction represents a reduction from four to three national facilities-based mobile network operators (a so-called "4-to-3 merger"), and that such a transaction would reduce competition and result in "higher prices, reduced innovation, reduced quality and fewer choices" in the marketplace.[1] This is an empirical question that has been studied by numerous scholars in recent years.

The upshot of the empirical literature is that, in fact, such mergers appear to *increase*, not decrease, innovation. Moreover, the research is, at best, inconclusive with respect to the price effects of such mergers. Based on these findings, we believe that the DOJ

[1] Competitive Impact Statement, United States of America, et al., Plaintiffs, v. Deutsche Telekom AG, et al., Defendants, Civil Action, United States District Court for the District of Columbia, No. 1:19-cv-02232-TJK, at 7 (Jul. 30, 2019), *available at* https://www.justice.gov/opa/press-release/file/1189336/download.

was correct to approve the transaction, and that this is so regardless of the expected competitive effects of the Final Judgment's Divestiture Package, which is likely unnecessary to ensure that the market remains competitive.

In a recent ICLE report,[2] attached to this comment, we assess the state of the existing empirical literature evaluating the effects of changes in market concentration (such as by merger) in the wireless telecommunications industry, and lay out the implications for subsequent mobile industry mergers that can plausibly be drawn from the literature. Although the existing empirical evidence is not conclusive with respect to the likely effects of any particular transaction,[3] it does offer sufficient data to challenge any claims that the proposed T-Mobile/Sprint transaction will reduce innovation and to call into question any assumptions that it will increase prices.

The report reviews 18 empirical analyses published in the last five years that study the effects of changes in market concentration in the wireless telecommunications industry. As we note in the report:

> [B]ecause analyses of past mergers are being used to support or critique a particular transaction (the proposed T-Mobile/Sprint merger), the purpose of this study is to assess and identify the utility of these past analyses in prospectively evaluating any particular transaction.[4]

Although, as noted, we question the utility of basing the evaluation of any particular transaction on the results of previous studies, a few general conclusions can be drawn from these previous studies. Most important among these:

1. "Of those analyses that looked at specific mergers, about half found that prices decreased following a merger whereas half found that prices increased. But there was no common measure of price effects across these studies...."[5]

---

[2] Eric Fruits, Justin (Gus) Hurwitz, Geoffrey A. Manne, Julian Morris, & Alec Stapp, *A Review of the Empirical Evidence on the Effects of Market Concentration and Mergers in the Wireless Telecommunications Industry*, ICLE Antitrust & Consumer Protection Research Program White Paper (Sep. 17, 2019), *available at* https://laweconcenter.org/wp-content/uploads/2019/09/ICLE-Telco_Merger_Lit_Review_Jud_Rpt_FINAL.pdf. Online appendices available at https://laweconcenter.org/wp-content/uploads/2019/09/ICLE-Telco_Merger_Lit_Review_ApendixFINAL.pdf.

[3] *See id.* at 23-24.

[4] *Id.* at 8.

[5] *Id.* at 11.

2. "Only about half of the studies considered investment effects. **Of those that found a statistically significant relationship, all found that network investment increased with a 4-to-3 merger.**"[6]

As we discuss in the report, on the basis of the studies reviewed, previous 4-to-3 mobile industry mergers appear to generate net benefits to consumer welfare in the form of increased investment, especially when the result is a more symmetrical market (with three players of more equal size)—as would be the case with the proposed T-Mobile/Spring merger. Meanwhile, based on the literature, it is simply incorrect to conclude that other countries that have allowed consolidation from four to three mobile wireless network operators have experienced price increases. In short, although the implications are necessarily uncertain for the proposed T-Mobile/Sprint transaction, nothing in the prior literature supports claims that the proposed transaction would harm consumer welfare on balance through increased coordination, reduced competition, or reduced incentive to innovate.

Of note—and because it is frequently cited and relied upon by critics of the proposed transaction—the ICLE report also analyzes and finds woefully wanting the methodology and proffered conclusions of the "Rewheel study," which purports to show that consumers in markets with three facilities-based providers paid twice as much per gigabyte as consumers in four-firm markets.[7] As we conclude, the Rewheel study

> focuses on an artificially constructed measure that does not represent real-world characteristics of competition; that measure focuses only on price effects to the exclusion of other effects, and even then it considers only two (non-realistic) consumption baskets to the exclusion of the fuller range of services consumers actually have available.[8]

It is wholly unreliable as a guide to the likely competitive effects of this or any other mobile industry merger.

---

[6] *Id.* at 12 (emphasis in original).

[7] *The state of 4G pricing–2H2018*, Rewheel/research (Oct. 26, 2018), *available at* http://research.rewheel.fi/downloads/The_state_of_4G_pricing_DFMonitor_10th_release_2H2018_PUBLIC.pdf.

[8] Fruits, et al., *A Review of the Empirical Evidence on the Effects of Market Concentration and Mergers in the Wireless Telecommunications Industry*, *supra* note 2, at 29. *See generally id. at* Part IV.

The studies we reviewed show once again that it is important to avoid confusing "competitors" with competition: the former is simply a number, while the latter is a dynamic process that depends on many factors. Thus the State AGs challenging the proposed deal are simply incorrect when they assert in their complaint that:

> According to the USDOJ and Federal Trade Commission 2010 Horizontal Merger Guidelines (the "Horizontal Merger Guidelines"), the Merger is presumptively anticompetitive because the HHI in the national market will increase by more than 200 points and result in an HHI above 2,500.[9]

To the contrary, a proper analysis suggests that the merger will likely be pro-competitive, regardless of—indeed, in part *because of*—its effect on market concentration. In this case, higher concentration will very likely *increase* competition between the subsequently more-equal-sized national players, and will thus both incentivize and enable increased investment in innovation and deployment of new technologies, including 5G wireless infrastructure.

In sum, there is no sound economic evidence from which to conclude that the proposed T-Mobile/Sprint transaction should be blocked on the grounds that it will lead to less competition and higher prices to consumers. On the contrary, the proposed merger would likely allow for higher levels of investment, especially in 5G technology, from which consumers would directly benefit.

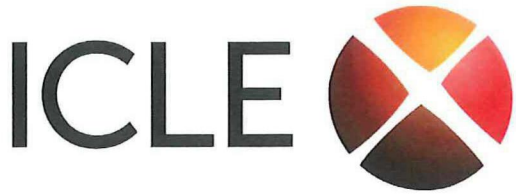
Respectfully Submitted,

Eric Fruits, Chief Economist
Justin (Gus) Hurwitz, Director of Law & Economics Programs
Geoffrey A. Manne, President
Julian Morris, Executive Director
Alec Stapp, Research Fellow

International Center for Law & Economics

---

[9] Redacted Third Amended Complaint, State of New York et al v. Deutsche Telekom et al, U.S. District Court of Southern New York, Case No. 1:19-cv-5434-VM-RWL, at 17.



A Review of the Empirical Evidence on the Effects of Market Concentration and Mergers in the Wireless Telecommunications Industry

Eric Fruits,[1] Justin (Gus) Hurwitz,[2] Geoffrey A. Manne,[3] Julian Morris,[4] and Alec Stapp[5]

ICLE Antitrust & Consumer Protection Research Program
White Paper 2019-09-17

The International Center for Law & Economics (ICLE) is a nonprofit, nonpartisan research center whose work promotes the use of law and economics methodologies to inform public policy debates. We believe that intellectually rigorous, data-driven analysis will lead to efficient policy solutions that promote consumer welfare and global economic growth.[6]

---

[1] Chief Economist, ICLE, and adjunct professor of economics at Portland State University.

[2] Director of Law & Economics Programs, ICLE, and assistant professor of law and co-director of the Space, Cyber, and Telecom Law program at the University of Nebraska College of Law.

[3] Founder and President, ICLE, and distinguished fellow at Northwestern Law School's Searle Center on Law, Regulation, & Economic Growth.

[4] Executive Director, ICLE, and Senior Fellow, Reason Foundation.

[5] Research Fellow, ICLE.

[6] ICLE has received financial support from telecom firms with diverse and often-divergent interests. We have also received financial support from non-telecom companies with similarly divergent interests. All ICLE financial support is general support, and no company's donation represents more than 10% of our budget. This work reflects the views of its authors and does not necessarily reflect the views of any of ICLE's donors, scholarly affiliates, or academic advisors.

Executive Summary

This report reviews 18 empirical analyses published in the last five years that study the effects of changes in market concentration (such as by merger) in the wireless telecommunications industry. Of those 18 studies, eight analyzed changes in market concentration across multiple jurisdictions between 2000 and 2015, while ten analyzed specific mergers. We also reviewed a recent study that considered the effects of market concentration in spectrum ownership in the U.S. on measures of quality.

Of the ten studies that looked at specific mergers, about half found that prices decreased following a merger whereas half found that prices increased. Even different studies of the *same* merger found wildly different effects on prices, ranging from significant price decreases to significant price increases. As regards the effect of mergers, including so-called 4-to-3 mergers, on price, the results might best be characterized as conclusively inconclusive.

We identified a number of reasons for these apparently divergent results, including:

- a lack of common measures of prices and price effects across studies;
- differences in the time period chosen; and
- difficulties accounting for variations in geography, demography and regulatory regimes between jurisdictions (the latter also creates a potential for endogeneity bias).

Of those studies that considered the effect on investment in 4-to-3 mergers, all found that capital expenditures, a proxy for investment, increased post-merger.

Several recent studies that looked more broadly at the effects of market concentration in the mobile telecommunications industry indicate that the highest levels of country-wide investment occurred in markets with three facilities-based operators (though total investment was not significantly lower in markets with four facilities-based operators). In addition, a recent analysis found that U.S. markets with higher concentration of ownership of spectrum had faster, more reliable cellular service.

Studies of investment also found that markets with three facilities-based operators had significantly higher levels of investment by individual firms. The implication is that in such markets, individual firms have stronger incentives to invest in the infrastructure that supports the range, quality, and quantity of services provided to

consumers. Studies also suggest this effect may be strengthened when the merger results in a market structure that is more symmetrical (i.e. the various facilities-based providers become more equal in market share).

From an investment perspective, the optimal number of wireless firms in a given market appears, in some studies, to be three; however, in some jurisdictions (such as those that are more densely populated), the optimal number may well be four, while in others (such as those with small populations that are widely dispersed) the optimal number may well be two. Regardless, there is little or no support for categorically claiming that the optimal number of firms in larger jurisdictions, or indeed in any jurisdiction, is four.

When evaluating the merits of a merger, authorities are charged with identifying the effects on the welfare of consumers. On the basis of the studies that we review, 4-to-3 mergers appear to generate net benefits to consumer welfare in the form of increased investment, while the effects on price are inconclusive.

Introduction

This study is prompted by the ongoing federal consideration of, and broader policy discussion about, the proposed merger of T-Mobile and Sprint.[7] As with previous mobile provider mergers, this merger has occasioned the frequent assertion that further concentration in the wireless telecommunications industry will be harmful to consumers,[8] and, in particular, that "it's going to be hard for someone to make a persuasive case that reducing four firms to three is actually going to improve competition for the benefit of American consumers."[9]

A central question in the review of this merger—as it is in all merger reviews—is the likely effects that the transaction will have on consumers. Some observers have characterized this merger—between the third and fourth largest mobile wireless providers in the United States—as a "4-to-3" merger, as it will reduce the number of large, ostensibly national carriers from four to three (though some have persuasively argued that such a characterization may not be accurate). A number of previous mergers around the world can or have also been characterized as 4-to-3 mergers in the wireless telecommunications industry.

A significant number of economic studies have evaluated the welfare effects of these and similar mergers in other countries, as well as the effects of market concentration in the wireless industry more generally. These studies have been used by both proponents and opponents of the proposed merger of T-Mobile and Sprint to support their respective contentions that the merger will benefit or harm consumer welfare.

---

[7] Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 18-197.

[8] *See, e.g.*, Petition to Deny of Free Press at 2, Applications of T-Mobile US, Inc. and Sprint Corporation For Consent to Transfer Control of Licenses and Authorizations (2018), WT Docket No. 18-197. ("[Applicants] have not shown that the deal would not lessen competition, far less that it could enhance competition. In fact, the merger would massively increase concentration in the U.S. wireless market and in critical market segments too.").

[9] *See, e.g.*, Sen. Amy Klobuchar, et al., Letter to Assistant Attorney General Makan Delrahim and FCC Chairman Ajit Pai (May 7, 2018) (*quoting* former Assistant Attorney General Bill Baer), *available at* http://bit.ly/2Kr4cVB.

This literature review comprises a critical appraisal of these economic studies of previous wireless industry mergers in other countries. Its purpose is to better understand what the existing body of empirical literature, taken as a whole, tells us about the likely consumer welfare effects of 4-to-3 mergers between wireless firms and the proposed T-Mobile/Sprint merger.[10]

The review begins with a narrative discussion of our findings. Section I briefly describes the studies reviewed and considers some of the methodological challenges. Section II discusses the findings regarding price and quality effects in the studies. Section III considers the relevant factors that affect the outcomes of the studies and their applicability to the assessment of future mergers. Section IV highlights the importance of a careful review of the empirical literature by critically evaluating the Rewheel study,[11] a report of wireless pricing which has been cited by opponents of the proposed T-Mobile/Sprint merger. The Rewheel study is not included among the set of empirical studies in this review because, as we demonstrate, it is deeply methodologically flawed. Section V concludes. Throughout this review, we refer to our more detailed, quantitative analysis of the studies, published separately as an Appendix.[12]

I. The Studies Reviewed and Methodological Challenges

We have reviewed 18 empirical analyses, published in the last five years, studying the effects of changes in market concentration (such as by merger) in the wireless telecommunications industry. Of those 18, eight analyzed changes in market concentration across multiple jurisdictions between 2000 and 2015,[13] while ten ana-

---

[10] Whether the merger of T-Mobile and Sprint is a true "4-to-3 merger" is beyond the scope of this study. Indeed, there is reason to believe that the merger is better characterized as a "2-to-3" merger by creating a symmetrical market structure of nationwide carriers.

[11] *The state of 4G pricing – 2H2018*, Rewheel/research (Oct. 26, 2018) at 6, http://research.rewheel.fi/downloads/The_state_of_4G_pricing_DFMonitor_10th_release_2H2018_PUBLIC.pdf ("Rewheel study").

[12] The Appendix is here: https://laweconcenter.org/wp-content/uploads/2019/04/ICLE-Telco_Merger_Lit_Review_ApendixFINAL.pdf

[13] Affeldt & Nitsche (2014); Csorba & Pápai (2015); Frontier (2015); Houngbonon & Jeanjean (2014); Jeanjean & Houngbonon (2015); Jeanjean & Houngbonon (2017); Ofcom (2016); WIK (2015).

lyzed specific mergers.[14] These 18 studies represent all the recent empirical studies of which we are aware that report estimated effects associated with the number of firms or changes in the number of firms, along with measures indicating whether the results are statistically significant (in contrast to, for example, the Rewheel study, which we discuss separately, IV, below). The specific mergers considered in these analyses are:

- T-Mobile/tele.ring (2006, Austria, 5-to-4),
- T-Mobile/Orange (2007, Netherlands, 4-to-3),
- T-Mobile/Orange (2010, UK, 5-to-4),
- Hutchinson/Orange (2012, Austria, 4-to-3),
- Hutchison/Telefonica (2014, Ireland, 4-to-3), and
- Telefonica/KPN (2014, Germany, 4-to-3).

In addition, we reviewed a recent study that considered the effects of market concentration in spectrum ownership in the U.S. on measures of quality.[15]

The complete results of our review are presented in the attached Appendix A;[16] a narrative summary of the results is presented below.

In general, our review raises significant questions about the utility of individual empirical studies, both in understanding the effects of past transactions and, especially, in predicting the likely effects of future transactions. The reviewed studies find divergent price effects possibly arising from similar-seeming mergers, and sometimes even from the *same* merger, ranging from significant price decreases to significant price increases. They also show a range of effects of mergers on quality of service and/or investment (although in all cases these effects are positive or neutral), both of which are, of course, essential to properly assessing a merger's consumer welfare effects.

Perhaps most important, our review demonstrates that any individual study is, in fact, *likely* to offer only a partial picture of the effects of a given merger, which may

---

[14] Aguzzoni, et al. (2015); Aguzzoni, et al. (2018); BEREC (2018); BWB (2016); Genakos, et al. (2018); GSMA (2017); Houngbonon (2015); HSBC (2015); Lear, et al. (2017); RTR (2016).

[15] Woroch (2019)

[16] https://laweconcenter.org/wp-content/uploads/2019/04/ICLE-Telco_Merger_Lit_Review_ApendixFINAL.pdf

be misleading. This is best seen in the empirical analyses of the 2012 Hutchison/Orange merger, a 4-to-3 merger in Austria. The Hutchison/Orange merger was specifically considered in seven of the analyses that we reviewed.[17] Of these, four found that the merger resulted in price *increases*, two found that it resulted in price *decreases*, and one did not study price effects at all. Collectively, the studies estimated the merger's price effects to range from between a 40 percent decrease and a 90 percent increase.[18] On the investment and/or quality front, three of the studies also found that the merger *increased* network investment and/or quality, while four analyses did not consider these effects.

Even taken collectively (and without reference to the objectivity of the individual studies), the studies of the Hutchison/Orange merger that we review present an incomplete picture of the likely effects of a given merger. In the advocacy context, for instance, one might expect such results to be portrayed by merger opponents as supporting the assertion that "4-to-3 mergers are twice as likely to cause price increases as decreases." While naively defensible (since four studies showed price increases, while only two showed decreases), such a statement does not fairly represent the actual effects either of the specific merger or 4-to-3 mergers in general. One reason is that only one of the studies spanned a long enough period-of-time to include the entry by mobile virtual network operators (MVNOs) that occurred in the studied market. As a result, it would be appropriate to characterize only this study as even *potentially* capturing long-run price effects.

By contrast, with respect to the effects on investment it would be rather more defensible to observe that "of those studies that found an effect on investment in 4-to-3 mergers, all found that investment increased post-merger."

In addition to the merger studies, we also reviewed two large-scale studies that investigated the relationship between market concentration and capital expenditures in the wireless telecommunications industry.[19] These studies—one of which looks at capital spending by firms in 199 countries between 2000 and 2014, and the other

---

[17] Aguzzoni, et al., (2015); Houngbonon (2015), HSBC (2015), RTR (2016), BWB (2016), and BEREC (2018); Genakos, et al. (2018). See Appendix Section 3.

[18] Appendix Section 3.

[19] Houngbonon and Jeanjean (2014) and HSBC (2015)

of which looks at capital spending by firms in 66 countries between 2003 and 2013—produce similar results, finding that firms' capital expenditures (a measure of investment in networks and a proxy for network quality) are maximized around a Lerner index of 37 to 38 percent (a rough proxy for market power). Based upon these findings, it appears that network investment is generally maximized in a market with three providers. Indeed, HSBC (2015) recommends the European approval of 4-to-3 mergers as a way to facilitate higher network investment with better outcomes for users.

We also reviewed two studies that looked at the relationship between market concentration and investment in a range of countries over 10-year periods. The first considered 38 countries between 2004 and 2013. The authors found that, broadly, investment followed an inverted-U curve, with the highest levels of investment occurring in markets with three operators, though markets with four operators had only slightly lower levels of total investment and the difference was not statistically significant. But, importantly, the study found that at the firm level investment was considerably lower in markets with four than in markets with three operators. Given the importance of firm level investment for improving quality and lowering prices over time, the authors conclude that "the unit price paid by consumer is larger with four firms than with three if the dynamic efficiency effect is significant."[20]

The second study considered 17 Western European markets between 2006 and 2015. It found that where the market is fully covered (i.e. where all consumers who might realistically have access to mobile telephony already have service of some kind), an increase in the number of firms tends to reduce overall investment.[21] Moreover, it found that where markets are asymmetric (i.e. some firms are significantly larger than others), the effect of an increase in the number of firms tends to have a more significant negative effect on investment by smaller firms. Thus, a merger that both reduces the number of firms and makes the market structure more symmetric, as is likely to be the case with the T-Mobile/Sprint merger, could potentially have significantly positive effects on both firm level and industry investment.

---

[20] Jeanjean and Houngbonon (2015)

[21] Jeanjean and Houngbonon (2017)

Finally, we reviewed a recently-published study that considered the relationship between measures of quality and carrier-level holdings of spectrum as a share of total holdings in 697 Cellular Market Areas (CMA) in the United States.[22] This study found that quality and coverage measures are positively related to carrier-level holdings of spectrum as a share of total holdings in the CMA. In particular higher carrier-level holdings of spectrum are associated with statistically significant broader 4G coverage, as well as generally faster and more reliable networks (with mixed statistical significance). In addition, Woroch (2018) concludes carriers with faster and more reliable networks and with a broader deployment of 4G technology are associated with more subscribers.

The purpose of our review is not to make predictions about any particular transaction, nor is it to express support for or concern about policy decisions that may have been undertaken in reliance on the empirical analysis of any past transaction. Rather, because analyses of past mergers are being used to support or critique a particular transaction (the proposed T-Mobile/Sprint merger), the purpose of this study is to assess and identify the utility of these past analyses in prospectively evaluating any particular transaction.

The results of our review suggest that the use of these empirical analyses for predictive purposes, either alone or collectively, is a fraught and ultimately unreliable endeavor, especially regarding the effects on price. But this does not mean that the studies do not offer valuable insights helpful for the review of any given merger. The value, however, is not for the most part in the "headline results" that the studies report; rather, the value is in the factors that the studies identify—or that can be identified from the studies—as affecting the outcomes of past (and, thus, presumably, future) mergers. Especially when taken as-a-whole, our review reveals a number of factors that should be considered when seeking to understand the likely welfare effects of a given merger. These include:

- whether the effects to be evaluated are limited to price or also include qualitative measures such as capital expenditures and other investment in quality of service;

---

[22] Woroch (2019)

- the effects on different tiers of service measured by hypothetical consumption profiles or "baskets";
- the presence or entry of MVNOs;
- the effects of different geographic circumstances or regulatory regimes on a given firm (including divestitures or other commitments imposed as part of the merger review process);
- the extent to which the effects of previous mergers may confound projected effects of the merger at-hand; and
- whether a transaction occurs during, or even as part of, a transition between different generations of technology (e.g., during an upgrade from 3G to 4G networks).

A. The relevance of empirical studies of past mergers to merger enforcement

The question at the heart of the regulatory review of, and enforcement decision regarding, a merger is whether the transaction's potential benefits to consumers outweigh its potential costs. Our review thus focuses on the evidence presented in the studies of past mergers that reliably pertains to the identifiable benefits and/or costs those mergers yielded for consumers.

Crucially, this requires consideration of merger effects *other* than merely price effects. Merger welfare effects are multi-dimensional. Evaluation of a merger with reference to only a single outcome—e.g., "prices went up" or "investment went down"—are invariably insufficiently nuanced and misleading.

The most obvious merger effects are price effects: increases or decreases in prices charged to consumers for a given quantity and quality of service. The traditional concern of competition law is that reduced competition allows firms greater ability to increase their profits by raising prices charged to consumers. But prices do not exist in a vacuum, and many mergers are undertaken specifically on the expectation that the combined firm will be able to improve quality or lower costs in ways that *also* affect consumer welfare. Of course, the converse may be true, as well: again, facing less competition, one concern of competition law is that firms will increase their profits by reducing product or service quality (thereby reducing the costs of providing those products or services) to the detriment of consumers.

At the same time, it is important to understand what is meant by reduced or increased "competition." A transaction that reduces the number of competitors within a market need not necessarily reduce *competition.* Rather, a merger might result in the creation of a more effective competitor to other incumbents, thereby potentially increasing competition, even while reducing the number of *competitors.* And a smaller number of larger firms facing more intense competition may be far better for consumers than a larger number of smaller, less-effective firms. For example, in examining the Hutchison/Orange merger in Austria, BEREC (2018) points out that in addition to the merger itself, in another transaction Hutchison spun off the Orange sub-brand Yesss! to A1 Telekom Austria, creating a "more symmetrical market structure."

Precisely because competition is multi-dimensional, and because a transaction may increase consumer welfare along one dimension (by increasing R&D investment, for example) while simultaneously reducing it along another (by raising short-term prices, for example), assessments and predictions of merger effects that focus solely on price are unlikely to offer an accurate picture of the overall effects of a merger on competition and consumer welfare. As the commentary on one recent study notes:

> [A] merger can be justified if there are large efficiency gains from the merger (e.g., because investments in the broadband networks increase). Hence, it is important to assess empirically the existence of this potential trade-off between efficiency gains and increases in prices charged to consumers.[23]

Contrary to the laments of some advocates for more aggressive antitrust enforcement,[24] American antitrust law has long recognized the importance of both price-

---

[23] Francesco Drago, Discussion of Christos Genakos, Tommaso Valletti & Frank Verboven, *Evaluating market consolidation in mobile communications*, 33 (93) ECON. POL'Y 86, 87 (2018).

[24] Kevin Caves and Hal Singer, *When the Econometrician Shrugged: Identifying and Plugging Gaps in the Consumer Welfare Standard*, GEORGE MASON L. R. (forthcoming), *available at* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3205518; Marshall Steinbaum, *The Consumer Welfare Standard Is an Outdated Holdover from a Discredited Economic Theory*, ROOSEVELT INSTITUTE (Dec. 11, 2017) *available at* http://rooseveltinstitute.org/consumer-welfare-standard-outdated-holdover-discredited-economic-theory/.

and non-price effects in evaluating the competitive effects of conduct.[25] The importance of both types of effects is expressly recognized in the Horizontal Merger Guidelines,[26] and has been consistently affirmed by the courts.[27] Thus our review assesses the studies' results along both of these dimensions.

II. Top-line Results

A. Effects on Price and Quality

A detailed, critical review of the studies' findings on price and quality, including summary tables, are provided in Appendix A. Our key findings from this review are:

- Of those analyses that looked at specific mergers, about half found that prices decreased following a merger whereas half found that prices increased.
- But there was no common measure of price effects across these studies. Some, for instance, considered low, medium, and high hypothetical consumption

---

[25] *See* Makan Delrahim, *All Roads Lead to Rome: Enforcing the Consumer Welfare Standard in Digital Media Markets*, Remarks as Prepared for Delivery at The Jevons Colloquium (2018) (noting that the consumer welfare standard is flexible, and the Court has long recognized the importance of factors such as innovation, consumer choice, and quality), *available at* https://www.justice.gov/opa/speech/file/1065096/download; *See also* Joshua D. Wright, *Antitrust Provides a More Reasonable Framework for Net Neutrality Regulation*, FREE STATE FOUNDATION (Aug. 16, 2017) at 6 ("The rule of reason, and antitrust jurisprudence generally, has evolved to reach all forms of competitive harms—including innovation and quality.") *available at* http://www.freestatefoundation.org/images/Antitrust_Provides_a_More_Reasonable_Framework_for_Net_Neutrality_Regulation_081617.pdf.

[26] U.S. Dep't of Justice & Fed. Trade Comm'n, Horizontal Merger Guidelines § 6.4 (rev. 2010), *available at* https://www.justice.gov/atr/horizontal-merger-guidelines-08192010#6d.

[27] As recently noted by the Supreme Court, "[d]irect evidence of anticompetitive effects would be 'proof of actual detrimental effects on competition,' such as reduced output, increased prices, or decreased quality in the relevant market," *Ohio v. American Express*, 585 U.S. ___ (2018) (holding that American Express's anti-steering practices did not violate antitrust law because, *inter alia*, "business model has spurred robust inter-brand competition and has increased the quality and quantity of credit-card transactions.") (quoting *FTC v. Indiana Federation of Dentists*, 476 U. S. 447, 460 (1986) (alterations omitted)). For examples of recent merger litigation alleging non-price effects, *see, e.g.*, FTC v. Sysco Corp., 113 F.Supp. 3d 1 (D.D.C. 2015); FTC v. Sanford Health (D.D.C. 2017); United States et al. v. Anthem, Inc., and Cigna Corp (D.D.C. 2016); United States v. H&R Block, Inc., 833 F.Supp. 2d 36 (D.C. Cir. 2011).

baskets,[28] while another considered smartphone and "traditional" device users.[29] Most, if not all, of the studies do not consider business or data-only plans.

- The study time periods varied such that some allowed for subsequent entry[30] while others were more narrowly short-run studies in which the measurement period was too short to allow for entry.[31]
- Only about half of the studies considered investment effects. **Of those that found a statistically significant relationship, all found that network investment increased with a 4-to-3 merger.**[32]
- One study found both increased investment and decreased prices (the best of all possible consumer outcomes, at least in terms of the direction of each effect)[33]
- Another study found increased investment effects as well as increased prices (at least in the short term). This result, while common, is perhaps the most difficult to parse in consumer welfare terms: Identifying the net welfare effect of divergent price and investment effects is difficult in absolute terms, but made even more complicated by generally requiring a comparison of short-run price effects with anticipated, long-run benefits from short-run investment.[34]

The results of our review are similar to those of other surveys of the empirical literature. BEREC (2018) (which offers both its own empirical analysis, so is included in our review, as well as its own survey of prior literature) notes that:

> It is clear that the evidence from the literature on the effects of 4-to-3 mergers is mixed (which is not surprising given the heterogeneity of the approaches and the events investigated). While there are studies which

---

[28] See, for example, Csorba & Pápai (2015), Aguzzoni, et al. (2018), Lear, et al. (2017), and BEREC (2018).

[29] RTR (2016).

[30] See, for example, BEREC (2018).

[31] See, for example, Genakos, et al. (2018), Houngbonon (2015), HSBC (2015), RTR (2016), and BWB (2016).[32] Houngbonon & Jeanjean (2014), Jeanjean & Hongbonon (2015), HSBC (2015), Genakos, et al. (2018), GSMA (2017).

[32] Houngbonon & Jeanjean (2014), Jeanjean & Hongbonon (2015), HSBC (2015), Genakos, et al. (2018), GSMA (2017).

[33] Lear, et al. (2017)

[34] Genakos, et al. (2018)

find significant price increases, there are also studies finding no price effects or even a decrease in prices or positive quality effects.

B. What the results tell us about prospective merger enforcement

Some of this inconclusiveness, especially with regard to the effects on prices, is a function of the difficulty, endemic to most empirical work of this kind, of reliably measuring even seemingly simple things like price changes. Moreover, comparing results across countries, years, and mergers is complicated, at best; like-kind comparisons are inevitably imperfect and the interpretation of results invariably defies simple slogans. Consider, for example, that (among other things):

- Different carriers offer different tiers of service with different qualitative characteristics (e.g., speed and data allowances);
- Carriers offer different promotions, payment terms, combinations of service, and the like such that there is rarely a single "price" at any given time;
- The prices for these services also change over time in response to exogenous factors (e.g., pricing pressures from competitors or changes in consumer preferences);
- A merger may yield short-run price effects on specific offerings that give way to different longer-run price effects, and it may change its service offerings over time to reflect changes in demand, cost, and the like; and
- All of this is compounded by the varying effects of different, merger-specific regulatory commitments or pricing constraints that may result from each merger.

All these factors make it difficult to measure how or even whether a given merger affects prices, and even more difficult to compare those effects across mergers.

> These measurement difficulties are compounded in the case of non-price effects. All of the same factors may apply to non-price effects (e.g., changes in the quality of service), but because non-price effects are generally not readily reduced to directly measurable or standardized units (as opposed to price which is, arguably, measurable and consistent), assessing and comparing non-price effects is that much more difficult. Many studies thus simply ignore non-price effects and focus on seemingly measurable characteristics. Those studies that do attempt to measure quality effects typically rely on proxies such as capital expenditures: In the wireless telecommunications industry, increased capex

> suggests that a firm is investing to improve its network either to accommodate higher quantities of usage (indicating lower costs of service per unit) or to accommodate higher qualities of service.

Given these considerations, the results of our review are unsurprising—and perhaps "unsexy." They are, however—and precisely because of this—policy-relevant. Our review of the 18 empirical studies of previous changes in concentration in the wireless industry are conclusively inconclusive as to the price effects of 4-to-3 or similar mergers.

III. Factors that Commonly Affect Study Results

Although the studies we reviewed do not produce consistent results with any predictive value for understanding the effects of a prospective merger, our evaluation of the studies nonetheless identifies a number of factors that should be considered when reviewing the likely competitive effects of comparable, prospective mergers. This result, as well, is not unique to our review. As Genakos, et al (2018) conclude:

> [T]he main pay-off from an understanding of the expected efficiencies arising from a horizontal merger is likely to be the insights this gives about the nature of competitive rivalry in an industry, which in turn will assist in gathering evidence on market dynamics and likely supply-side responses. Such evidence should not be an after-thought. It deserves a central role in a unilateral effects assessment that justifies a departure from the constraints imposed by simple theoretical static models.

In particular, our review suggests that the following four elements should be included in any review of a wireless telecommunications industry merger:

1. Evaluation of both price and non-price factors;
2. Evaluation of the full range of product and service offerings, including an accounting of the relevant differences in the cost inputs to each;
3. Assessment of the timing and effects of MVNO entry and ongoing competition on the marketplace; and
4. Accounting for the effects on conduct and merger outcomes of transaction-specific regulatory, technological, geographic, and other characteristics of the merging parties and their competitive environment.

Some of these factors are particularly important to consider when evaluating a transaction on its own merits; others are more relevant to the comparison of a prospective transaction with potentially analogous, prior ones.

A. Challenges measuring price effects

Most research evaluating the relationship between the number of firms or firm concentration and wireless carrier prices relies on published tariffs as a measure of price. Many of these studies, such as Aguzzoni et al. (2018), Lear et al. (2017), and Genakos et al. (2015) use a price-basket approach. They define "high," "medium," and "low" usage profiles (or "baskets") based on the consumption of voices, minutes, and data, and then identify the lowest-cost tariff or set of tariffs for each user profile and for each period and compute the average mobile expenditure. In most studies, information for only the two largest carriers is available.

The reliance of information from only the largest carriers in a country may produce biased results inasmuch as smaller carriers and MVNOs may engage in competitive pricing strategies that benefit consumers and discipline larger firms. Thus it is possible, if not likely, that nearly all studies suffer from an upward bias in their measures of price.

Affeldt & Nitsche (2014) criticize the use of tariff data:

> Such approaches are taken by Rewheel (2013) and also the Austrian regulator rtr (when tracking prices over time, see rtr (2014)). Such studies face the following problems: They may pick tariffs that are relatively meaningless in the country. They will have to assume one or more consumption baskets (voice minutes, data volume etc) in order to compare tariffs. This may drive results. Apart from these difficulties such comparisons require very careful tracking of tariffs and their changes. Even if one assumes studying a sample of tariffs is potentially meaningful, a comparison across countries (or over time) would still require taking into account key differences across countries (or over time) like differences in demand, costs, network quality etc. We are not aware of any study which does this carefully.

Lear et al. (2017), which uses the usage profile approach based on baskets defined by the OECD, concedes that the approach has several drawbacks in that "it re-

quires making several assumptions on the 'representative' usage profile and may be based on tariffs that are irrelevant for the country."

None of the studies reviewed report the share of consumers represented by each of the hypothetical baskets used. Thus, even if a study reports a large, sustained price increase for a "high" basket, and small decreases for "medium" and "low" baskets, for example, it is still impossible to infer a net consumer welfare loss from the relative magnitudes of the effects because there is no way to know what fraction of the market is subject to each of them.

Perhaps more important for antitrust review is the implicit presumption that each usage profile represents a distinct product market. There is widespread agreement that there is considerable churn of consumers between wireless providers with often differing service offerings, and that usage patterns vary across countries and time. These dynamics suggest that there is no bright line separating the wireless market into distinct product markets distinguished by usage.

Another approach uses the average revenue per user (ARPU) as a measure of prices. On the one hand ARPU has the advantage that it captures, to some degree, the actual (average) cost to consumers. On the other hand, however, this straightforward measure does not distinguish between price and usage level: An increase in revenues may be attributed to indeterminate combinations of either or both increased prices and/or increased usage per user. Studies such as Affeldt & Nitsche (2014) use ARPU while accounting for usage, a measure they call "effective price per minute" (EPPM), but this measure is related only to voice services.

Finally, and as discussed in more detail below, every study suffers from one of more of the following complications:

- Failure to account for differences in pre- and post-paid plans,
- Exclusion of business plans,
- Exclusion of data-only plans,
- Computation of prices without handset subsidies,
- Failure to account for MVNO entry and/or MVNO pricing, and/or
- Failure to consider competition from smaller mobile network operators (MNOs).

In addition to data considerations, it is also important to consider the analytical approaches taking in the research. Most pricing studies employ a difference-in-difference approach, a synthetic control group approach, or both approaches.

With a difference-in-differences approach, price effects are estimated by comparing the differences between the price trends in the country being examined (the country affected by the merger, or the "treatment" country) and prices in several unaffected countries (the "control" countries.) The approach is intended to statistically estimate the difference between the pre-merger differences and the post-merger differences, giving the procedure the name difference-in-differences.

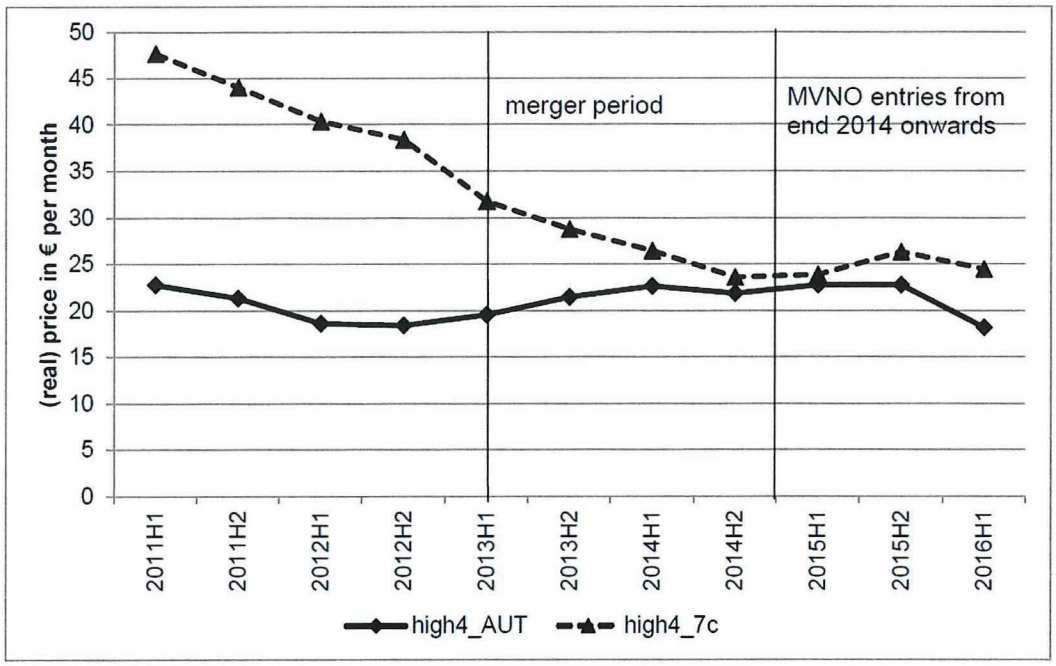
The synthetic control approach combines elements from matching and difference-in-differences approaches. Rather than using a large set of different control countries, the synthetic control approach identifies a smaller subset of control countries that have statistically similar pre-merger price trends. The difference-in-differences approach is then applied to treatment country and the smaller subset.

Both approaches have gained acceptance *in other contexts*. However, in evaluating the results of such studies in the context of mergers, caution should be exercised. In particular, the results of the approaches may find a statistically significant positive increase in the differences. However, this result does not indicate that a merger led to higher absolute prices for consumers. A difference-in-differences approach in each of the following hypotheticals would lead to a conclusion the merger led to higher prices.

1. **Pre-merger:** Treatment and control have same prices.
   Post-merger: Treatment prices increase 10 percent, and control countries prices are unchanged.
2. **Pre-merger:** Treatment and control have same prices.
   Post-merger: Treatment prices are unchanged, and control countries prices decrease 10 percent.
3. **Pre-merger:** Treatment and control have same prices.
   Post-merger: Treatment prices decrease 5 percent, and control countries prices are decrease 10 percent.

In only one of the hypothetical examples does the country in which the merger takes place experience an increase in absolute prices. In the other example, the country with the merger simply did not experience the same decrease as the control

countries. Thus, one cannot infer high absolute post-merger prices from examining difference-in-differences results alone.

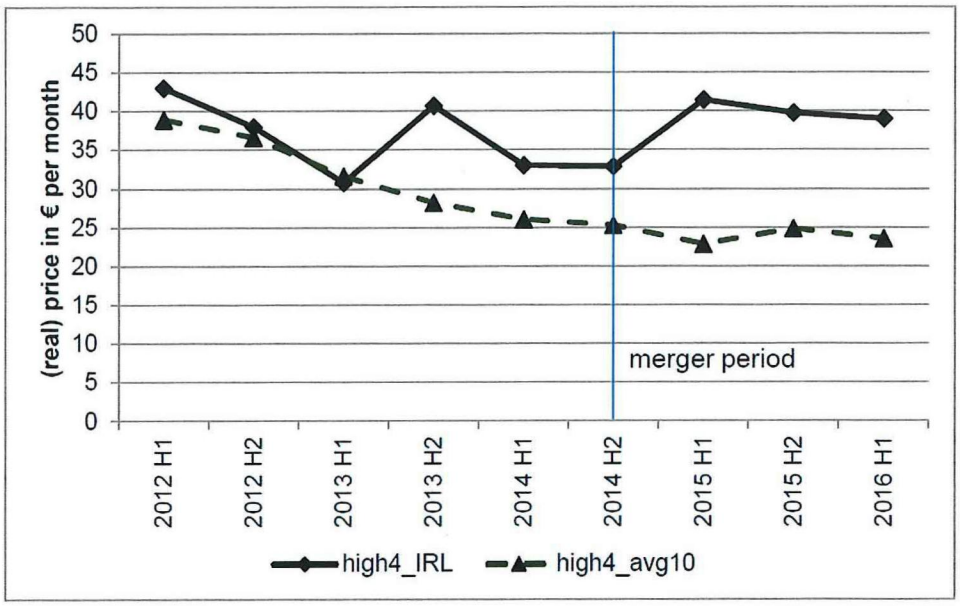


7c refers to an average of the seven control group countries BE, DK, ES, EL, IT, PT, SE

Figure 6: Price trends for users with a high usage profile in Austria
Source: BEREC (2018)

For example, BEREC's (2018) study of the Hutchison/Orange merger in Austria finds a statistically significant positive increase in the differences between Austria (the treatment country) and the control countries, especially for the "high" bundle of hypothetical usage. However, Figure 6 from the study, shown above, indicates much of the price difference between Austria and comparison countries results from a decline in comparison country prices, rather than increases in prices in Austria.

Similarly Figure 9 from BEREC's (2018) analysis of the Hutchison/Telefónica merger in Ireland, shown below, indicates much of the price difference between Ireland and comparison countries for the high basket results from a decline in comparison country prices, rather than increases in prices in Ireland.



avg10 refers to a simple average of the ten control group countries

Figure 9: Price trends for users with a high usage profile in Ireland

Source: BEREC (2018)

B. Evaluation of both price and non-price factors

A first and, frankly, obvious observation from our review of these studies is that it is essential to consider both the price and non-price effects of a transaction in order to assess its likely net effect on consumer welfare. This is well-trod merger law in the United States, yet advocates frequently focus on price-effects to the exclusion of non-price effects, and regulators often allow price-effects to overdetermine their evaluations of proposed transactions.

The empirical analyses we survey demonstrate both the extent to which merger policy can be myopically focused on price effects and the reasons that this is problematic. Roughly half of the empirical studies of 5-to-4 and 4-to-3 mergers do not look at non-price effects at all. Of those that do, *all* find likely positive (i.e. beneficial) non-price effects.[35] This suggests that pro-consumer non-price effects are prevalent

[35] Genakos, et al. (2018), GSMA (2017), Houngbonon & Jeanjean (2014), Jeanjean & Hongbonon (2015), HSBC (2015).

in these transactions. Studies that do not consider these effects are incomplete for purposes of evaluating the mergers' consumer welfare effects, and all-too-easily used by advocates to misleadingly predict negative consumer outcomes. This is not necessarily a criticism of the studies themselves, which generally do not make comprehensive policy conclusions. The reality is that it is exceptionally difficult to comprehensively study even price effects, such that a well-conducted study of price effects alone is a valuable contribution to the literature. Nevertheless, in the context of evaluating prospective transactions, the results of such studies must be discounted to account for their exclusion of non-price effects.

Quality improvements attributable to network investment are especially crucial to evaluating the welfare effects of telecommunications industry mergers occurring in large and/or sparsely populated countries or regions or areas with a large rural population (see Section III.D below), and during periods of technological transition—such as from 3G to 4G, or 4G to 5G networks. This is true both as it reflects the deployment of more technologically advanced services, but also as a determinant of future price competition.

Firms "race" to deploy new technologies both so that they can offer customers a higher-quality product (and correspondingly charge more for that product) and also so that, if they "win" that race compared to their peers, they will benefit from a period of reduced competition while other firms continue to upgrade their own networks.[36] Mergers that occur during periods of technological dynamism may tend to increase the short-term, negative price effects of monopolistic competition, allowing firms to raise their prices further above marginal cost than in periods of static technologies, during which firms instead compete on price alone. But that effect may also increase the pace of deployment of a next-generation technology, during a period that the firm's competitors are also deploying their own next-generation technologies, thus benefitting consumers in the short-run (by allowing them access to

---

[36] See generally: Schumpeter, Joseph A. (1950) *Capitalism, Socialism, and Democracy.* 3d ed. New York: Harper and Brothers.

more advanced technology sooner) and also in the long-run (as completion of these improved networks facilitates price competition).[37]

C. Evaluation of the full range of product and service offerings and an accounting of their cost differences

One of the primary reasons that empirical studies of price effects show different results when analyzing the same transactions is that each study may consider prices for a different set of services, or different aspects of multi-part prices within a transaction. Ironically, this typically presents a greater challenge for price-effects than for non-price effects. This is because markets such as wireless telecommunications often involve a wide range of pricing options for different users and services, with the result that there are so many possible prices to consider that meaningful comparison is often impossible. By contrast, when it comes to non-price effects, researchers more often face the challenge of finding *any* relevant measurements.

In the case of the studies we reviewed, we find studies measuring a range of different price effects: prices associated with varying combinations of high, medium, and low hypothetical consumption profiles; short-run and long-run prices; prices for service plans that both do and do not include subsidized features such as handsets; and prices for both pre- and post-paid service. Additionally, the studies generally exclude certain types of plans that may provide important information about the competitive effects of a transaction, such as business-tier and data-only plans.

D. Assessment of the effects of MVNO entry and competition on the marketplace

One of the most significant factors affecting competition in the wireless marketplace is the entry, ongoing presence (or absence), and consumer usage of mobile virtual network operators (MVNOs). Yet most studies, including those that found negative (consumer) price-effects, did not explicitly account for the possibility that MVNO competition could exert downward pricing pressure on merged firms. The absence of an assessment of the possibility or actuality of MVNO competition is particularly likely to lead to misleading conclusions because MVNOs, given their

---

[37] See e.g. Declaration of David S. Evans in the Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 18-197, Appendix G, at 112 ff.

structure as resellers of facilities-based providers' (also known as mobile network operators, or MNOs) services, benefit from certain advantages as a means of disciplining prices relative to mobile network operators, such as: the ability to leverage existing brands and retail marketing infrastructure (and in some cases relevant physical infrastructure, such as a fiber-optic network), while avoiding the need for investment in network-wide cellular infrastructure and spectrum licenses.[38] Meanwhile, as Michelle Connolly (2018) notes:

> With multiple MNOs competing for MVNOs that have access to unique consumer segments, MVNOs are able to obtain competitive wholesale rates. This leads to lower overall prices, due to greater economies of scale in the upstream market, and increased price/quality discipline in the downstream retail market.

These effects are seen, for instance, in the studies evaluating the 2012 Hutchison/Orange merger in Austria. Five of the six studies of this merger that we review look at merger effects occurring in a timeframe that does not include the entry of MVNOs into the marketplace in 2015. The only study that did consider the market's competitiveness following *both* the merger and the subsequent entry of MVNOs was BEREC (2018), which notes that:

> In 2016 H1 (first half of 2016), the [price-effects] became considerably smaller and statistically insignificant in most specifications (although, for the medium usage basket, some effect in 2016 H1 cannot be ruled out completely). This is likely caused by competitive pressure from MVNOs, which gained significant market share since entry at the beginning of 2015.

Similarly, Lear, et al.'s (2017) study of the 2010 T-Mobile/Orange merger notes that the firms' combined market share decreased by 6.4 percent in the four years following the merger and suggests that this may have been due in part to competition from MVNOs (which grew in market share by 2.3 percent in the same period).

Meanwhile, it is likely just as important to consider the effect of smaller carriers on the overall mix of services and prices available in the market following a merger. Because of limitations in available data, many studies focus on only the largest car-

---

[38] Banerjee and Dippon (2009)

riers in a country or region, to the exclusion of smaller carriers that may not be seen as a substitute for the services offered by larger carriers because their offerings are more limited in geographic scope. No studies that we reviewed expressly considered the role of smaller carriers, but it is reasonable to expect that they could have a price-disciplining effect comparable to that of MVNOs, especially in markets in which regional carriers are more common (such as in parts of the United States).[39] While Csorba & Pápai (2015) and Ofcom (2016), consider the effects of "disruptive" carriers, such carriers can, in principle, be large or small.

E. Accounting for transaction-specific characteristics of the merging parties and their competitive environment

A final factor that bears consideration relates to how (or whether) to use the results of a prior transaction to understand the likely effects of a future transaction. It is entirely possible that exogenous factors affecting a given transaction will predominate over any likely consistencies attributable to structural similarities with past transactions. The key selection factor for the empirical studies that we reviewed was that they focused on four versus three firm, or similarly concentrated, markets in the wireless telecommunications industry. But the fact that a future proposed transaction is also a 4-to-3 wireless merger does not automatically mean that these studies meaningfully bear upon it.

It is as important to consider the regulatory, geographic, and technological setting of a merger as it is to consider the transaction's market structure. A transaction undertaken in a regulatory regime with strong *ex post* enforcement of competition law, or with substantial experience designing and implementing effective *ex ante* remedies in its transaction reviews, for example, is likely to lead to very different effects than a transaction undertaken in a different regulatory environment.[40]

Perhaps even more important to understanding the implications for US mergers of the merger studies included in this review is that all of the mergers evaluated in those studies were European. The dramatically different geography of the United

---

[39] For example, Jeanjean & Houngbonon (2015) exclude the U.S. and Canada from their study because the presence of regional carriers "makes it difficult to assess the impact of the number of firms."

[40] See e.g. Jeanjean and Houngbonon (2017) at 13-16.

States imposes vastly different constraints upon telecommunications providers than do the geographies of the countries in which these mergers took place. Austria, the Netherlands, Ireland, the UK, and even Germany are much smaller countries, with far fewer people, and much simpler geographies, than the United States. At the margin, smaller countries–especially those with greater population densities–are likely to see a greater portion of consumer benefit from a transaction arising from lower prices than from infrastructure investment. Larger countries–especially those, like the United States, with huge swaths of land with minimal population density and a larger rural population–require significant capital expenditures to provide comprehensive coverage. For example, GSMA (2015) finds that higher population density in a country has a statistically significant positive relationship with 4G coverage levels. The consumer welfare benefits of mergers in larger countries are much more likely to arise from network investment.

IV. A Cautionary Example: The Rewheel Study

As problematic as it is to apply otherwise methodologically sound studies to subsequent mergers, it is even more problematic to apply methodologically *unsound* studies to any purpose at all. Whatever the problems of making inferences from the studies discussed in our review, there is no basis at all for accepting any predictions or assessments based on fundamentally flawed studies. Our review of the relatively high-quality studies included here also provides a useful point of reference for distinguishing and disregarding studies that fail to offer any intrinsically reliable findings.

In his testimony before the House Committee on Energy & Commerce, Subcommittee on Communications & Technology, Phillip Berenbroick of Public Knowledge referred to "[a]n October 2018 report from Finnish research firm Rewheel[, which] found that consumers in markets with three facilities-based providers paid twice as much per gigabyte as consumers in four firm markets."[41] The Rewheel Study that Mr. Berenbroick relied upon, however, is marred by a number of significant flaws, which undermine its usefulness.

---

[41] Testimony of Phillip Berenbroick, Senior Policy Counsel, Public Knowledge, Before the U.S. House of Representatives Committee on Energy & Commerce Subcommittee on Communications & Technology, *Protecting consumers and competition: An examination of the T-Mobile and Sprint merger* (Feb. 13, 2019), *citing* Rewheel study, *supra* note 11, at 6.

Rewheel's report purports to analyze the state of 4G pricing across 41 countries that are either members of the EU or the OECD or both. The report's conclusions are based mainly on two measures:

1. Estimates of the *maximum* number of gigabytes available under each plan for a specific hypothetical monthly price, ranging from €5 to €80 a month. In other words, for each plan, Rewheel asks, "How many 4G gigabytes would X euros buy?" Rewheel then ranks countries by the median amount of gigabytes available at each hypothetical price for all the plans surveyed in each country.
2. Estimates of what Rewheel describes as "fully allocated gigabyte prices." This is the monthly retail price (including VAT) divided by the number of gigabytes included in each plan. Rewheel then ranks countries by the median price per gigabyte across all the plans surveyed in each country.

A. Rewheel's convoluted calculations

Rewheel's use of the country median across all plans is problematic. In particular it gives all plans equal weight, regardless of consumers' use of each plan. For example, a plan targeted for a consumer with a "high" level of usage is included with a plan targeted for a consumer with a "low" level of usage. Even though a "high" user would not purchase a "low" plan (which would be relatively expensive for a "high" user), all plans are included, thereby skewing upward the median estimates.

But even if that approach made sense as a way of measuring consumers' willingness to pay, in execution Rewheel's analysis contains the following key defects:

- The Rewheel report is essentially limited to quantity effects alone (i.e., how many gigabytes available under each plan for a given hypothetical price) or price effects alone (i.e., price per included gigabyte for each plan). These measures can mislead the analysis by missing, among other things, innovation and quality effects.
- Rewheel's analysis is not based on an impartial assessment of relevant price data. Rather, it is based on hypothetical measures. Such comparisons say nothing about the plans actually chosen by consumers or the actual prices paid by consumers in those countries, rendering Rewheel's comparisons virtually meaningless, as noted by Affeldt & Nitsche (2014).

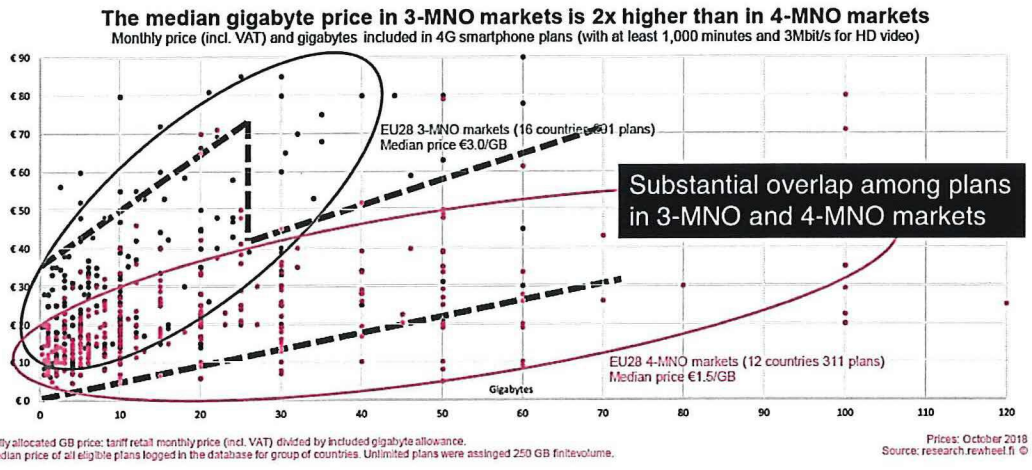
- The Rewheel report bases its comparison on dissimilar service levels by not taking into account, for instance, relevant features like comparable network capacity, service security, and, perhaps most important, overall quality of service.

B. Rewheel's unsupported conclusions

Rewheel uses its analysis to come to some strong conclusions, such as the conclusion on the first page of its report declaring the median gigabyte price in countries with three carriers is twice as high as in countries with four carriers.

The figure below is a revised version of the figure on the first page of Rewheel's report. The yellow blocks (gray dots) show the range of prices in countries with three carriers the blue blocks (pink dots) shows the range of prices in countries with four carriers. The darker blocks show the overlap of the two. The figure makes clear that there is substantial overlap in pricing among three and four carrier countries. Thus, it is not obvious that three carrier countries have significantly higher prices (as measured by Rewheel) than four carrier countries.

A simple "eyeballing" of the data can lead to incorrect conclusions, in which case statistical analysis can provide some more certainty (or, at least, some measure of uncertainty). Yet, Rewheel provides no statistical analysis of its calculations, such as measures of statistical significance. However, information on page 5 of the Rewheel report can be used to perform some rudimentary statistical analysis.



The information from the columns for hypothetical monthly prices of €30 a month and €50 a month can be converted into a hypothetical price per gigabyte to generate the dependent variable. Following Rewheel's assumption, "unlimited" is converted to 250 gigabytes per month. Greece is dropped from the analysis because Rewheel indicates that no data is available at either hypothetical price level.

This rudimentary statistical analysis includes the following independent variables:

- Number of carriers (or mobile network operators, MNOs) reported by Rewheel in each country, ranging from three to five. Israel is the only country with five MNOs.
- A dummy variable for EU28 countries. Rewheel performs separate analysis for EU28 countries, suggesting they think this is an important distinction.
- GDP per capita for each country, adjusted for purchasing power parity. Several articles in the literature suggest higher GDP countries would be expected to have higher wireless prices.
- Population density, measured by persons per square kilometer. Several articles in the literature argue that countries with lower population density would have higher costs of providing wireless service which would, in turn, be reflected in higher prices.

The tables below confirm what an eyeballing of the figure suggest: Rewheel's data show the number of MNOs in a country have no statistically significant relationship with price per gigabyte, at either the €30 a month level or the €50 a month level.

Dependent variable: Price per GB at €30 per month

	Coeff.	Std. Err.	t-stat	p-value
Intercept	9.536	6.676	1.43	0.162
Number of MNOs	-1.854	1.692	-1.10	0.281
EU28 country dummy	-0.332	1.955	-0.17	0.866
GDP per capita (PPP)	-1.6E-05	5.5E-05	-0.29	0.771
Population density	0.003	0.004	0.76	0.455
R-squared	0.05			
Observations	40			

Dependent variable: Price per GB at €50 per month

	Coeff.	Std. Err.	t-stat	p-value
Intercept	3.067	2.006	1.53	0.135
Number of MNOs	-0.597	0.509	-1.17	0.249
EU28 country dummy	0.023	0.587	0.04	0.968
GDP per capita (PPP)	1.5E-06	1.7E-05	0.09	0.928
Population density	0.001	0.001	0.56	0.577
R-squared	0.05			
Observations	40			

While the signs on the MNO coefficient are negative (i.e., more carriers in a country is associated with lower prices), they are not statistically significantly different from zero at any of the traditional levels of statistical significance.

Also, the regressions suffer from relatively low measures of goodness-of-fit. The independent variables in the regression explain approximately five percent of the variation in the price per gigabyte. This is likely because of the convoluted way Rewheel measures price, but is also due to the known problems with performing cross-sectional analysis of wireless pricing, as noted by Csorba & Pápai (2015):

> Many regulatory policies are based on a comparison of prices between European countries, but **these simple cross-sectional analyses can lead to misleading conclusions because of at least two reasons. First, the price difference between countries of n and (n + 1) active mobile operators can be due to other factors, and the analyst can never be sure of having solved the omitted variable bias problem.** Second and more importantly, the effect of an additional operator estimated from a cross-sectional comparison cannot be equated with the effect of an actual entry that might have a long-lasting effect on a single market.

C. The Rewheel report cannot be relied upon in assessing consumer benefits or harm associated with the T-Mobile/Sprint merger, or any other merger

Rewheel apparently has a rich dataset of wireless pricing plans. Nevertheless, the analyses presented in its report are fundamentally flawed. Moreover, Rewheel's conclusions regarding three vs. four carrier countries are not only baseless, but clearly unsupported by closer inspection of the information presented in its report. The Rewheel report cannot be relied upon to inform regulatory oversight of the T-Mobile/Sprint merger or any other.

The Rewheel study is, in effect, the epitome of a flawed study and the opposite of the approach that we have attempted to take in our analysis. It focuses on an artificially constructed measure that does not represent real-world characteristics of competition; that measure focuses only on price effects to the exclusion of other effects, and even then it considers only two (non-realistic) consumption baskets to the exclusion of the fuller range of services consumers actually have available. While every study we have reviewed necessarily makes certain limiting assumptions, either as a reflection of data limitations inherent in these sorts of empirical studies or of the necessity of limiting the scope of analysis in order to yield a manageable undertaking, the extent of the Rewheel study's assumptions and limitations is breathtaking. If anything, the Rewheel study demonstrates the importance of rigorous critical literature reviews such as this one, which endeavor to systematically synthesize results across a wide range of empirical analyses in order to discern the legitimate generalized understandings that may be gleaned from such a complex data set. The Rewheel study, by contrast, is a careless mish-mash of data points from which no reliable conclusions can be draw.

Conclusion

This review of studies looking at the effects of changes in market concentration in the mobile telecommunications industry has highlighted numerous challenges facing researchers undertaking such studies—as well as the resulting challenges for the regulators and others trying to use studies such as these to predict the future effects of any given merger.

These challenges appear to be most acute when trying to analyze the effects of mergers on prices of mobile offerings. As we noted above, studies of these effects yield

conclusively inconclusive results. The authors of most of these studies acknowledge these challenges and do not pretend that their results are in any way definitive. Unfortunately, others have used the findings in these studies selectively and without reference to the challenges in order to claim, erroneously, to have found more conclusive evidence of price effects.

Some studies, most notably the Rewheel analysis described in section IV, take a more cavalier approach, drawing conclusions that are simply not grounded in a sound analysis of the evidence.

Studies that look at the effect of market concentration on investment consistently find a positive correlation between concentration and investment at both the industry and firm level. From an investment perspective, the optimal number of wireless firms in a given market appears, in some studies, to be three; however, in some jurisdictions (such as those that are more densely populated), the optimal number may well be four, while in others (such as those with small populations that are widely dispersed) the optimal number may well be two. There is little or no support for categorically claiming that the optimal number of firms in larger jurisdictions is four.

The finding, in the only study that specifically investigated the issue, that increases in the number of competitors in asymmetric markets leads to disproportionately lower levels of investment by smaller firms, suggests that a merger between two smaller firms that results in greater market symmetry is likely to result in higher levels of investment by the merged firms relative to the unmerged entities.

These findings have implications for dynamic efficiency, since higher levels of investment are plausibly correlated with more rapid roll-out of new technologies, improved service for customers and, over time, reduced costs. This is likely to be particularly true during periods when new generations of mobile communications are being rolled out.

From a consumer welfare perspective, it seems plausible that in a large, geographically dispersed market such as the U.S., facing the prospective introduction of 5G, the optimal number of national facilities-based mobile telecommunications firms may well even be fewer than four.

Studies Reviewed

Affeldt, Pauline and Rainer Nitsche (2014). "A Price Concentration Study on European Mobile Telecom Markets: Limitations and Insights." EMST Working Paper 14-07. European School of Management and Technology. https://www.esmt.org/price-concentration-study-european-mobile-telecom-markets-limitations-and-insights.

Aguzzoni, Luca, Benno Buehler, Luca Di Martile, Georg Ecker, Ron Kemp, Anton Schwarz, and Robert Stil (2015). "Ex-Post Analysis of Two Mobile Telecom Mergers: T-Mobile/tele.ring in Austria and T-Mobile/Orange in The Netherlands." European Commission, Directorate-General for Competition. http://ec.europa.eu/competition/publications/reports/kd0215836enn.pdf.

Aguzzoni, Luca, Benno Buehler, Luca Di Martile, Ron Kemp, and Anton Schwarz (2018). "Ex-post Analysis of Mobile Telecom Mergers: The Case of Austria and The Netherlands." *De Economist* 166(1):63-87. doi:doi.org/10.1007/s10645-017-9308-5.

Allen, James, Paolo Buccirossi, Tomaso Duso, Fabio Fradella, Alessia Marrazzo, Mattia Nardotto, Salvatore Nava, and Jo Seldeslachts (2017). "Economic Impact of Competition Policy Enforcement on the Functioning of Telecoms Markets in the EU." Prepared by Lear, DIW Berlin and Analysys Mason for the European Commission, Directorate-General for Competition. http://ec.europa.eu/competition/publications/reports/kd0417233enn.pdf. Cited as Lear et al. (2017).

Banerjee, Aniruddha and Christian M. Dippon (2009). "Voluntary Relationships Among Mobile Network Operators and Mobile Virtual Network Operators: An Economic Explanation." *Information Economics and Policy* 21(1): 72-84. https://www.sciencedirect.com/science/article/pii/S016762450800070X

Body of European Regulators for Electronic Communications (BEREC) (2018). "BEREC Report on Post-Merger Market Developments: Price Effects of Mobile Mergers in Austria, Ireland and Germany." BoR (18) 119. https://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/8168-berec-report-on-post-merger-market-devel_0.pdf.

Bundeswettbewerbsbehörde (BWB (2016). "The Austrian Market for Mobile Telecommunication Services to Private Customers: An Ex-post Evaluation of the Mergers H3G/Orange and TA/Yesss!" BWB/AW-393. https://www.bwb.gv.at/fileadmin/user_upload/PDFs/BWB2016-summary-Ex-post_evaluation_of_the_mobile_telecommunications_market.pdf.

Connolly, Michelle (2018). *Competition in Wireless Telecommunications: The Role of MVNOs and Cable's Entry into Wireless.* https://newtmobile.com/content/uploads/2018/09/Competition-in-Wireless-Telecommunications-Michelle-Connolly.pdf

Csorba, Gergely and Zoltán Pápai (2015). "Does One More or One Less Mobile Operator Affect Prices? A Comprehensive Ex-Post Evaluation of Entries And Mergers in European Mobile Telecommunication Markets." MT-DP – 2015/41. Hungarian Academy of Sciences, Center for Economic and Regional Studies. http://econ.core.hu/file/download/mtdp/MTDP1541.pdf.

Elixmann, Dieter, Ilsa Godlovitch, Iris Henseler-Unger, Rolf Schwab, and Ulrich Stump (2015). "Competition & Investment: An Analysis of the Drivers of Investment and Consumer Welfare in Mobile Telecommunications." Prepared by WIK-Consult, GmbH for Ofcom. https://www.ofcom.org.uk/__data/assets/pdf_file/0029/78365/competition_and_investment_mobile.pdf. Cited as WIK (2015).

Frontier Economics (2015). "Assessing the Case for In-Country Mobile Consolidation: A Report Prepared for the GSMA." https://www.gsma.com/publicpolicy/wp-content/uploads/2015/05/Assessing_the_case_for_in-country_mobile_consolidation.pdf

Genakos, Christos, Tommaso Valletti, and Frank Verboven (2018). "Evaluating Market Consolidation in Mobile Communications." *Economic Policy* 33(93):45-100. doi: doi.org/10.1093/epolic/eix020.

Houngbonon, Georges Vivien and Francois Jeanjean (2014). "Is There a Level of Competition Intensity That Maximizes Investment in the Mobile Telecommunications Industry?"

https://www.orange.com/en/content/download/29806/833600/version/2/file/SSRN_id2416780.pdf.

Houngbonon, Georges Vivien (2015). "The Impact of Entry and Merger on the Price of Mobile Telecommunications Services." Paper presented at 26th European Regional Conference of the International Telecommunications Society, Madrid, Spain, June 24-27. http://hdl.handle.net/10419/127148.

HSBC (2015). "Supersonic: European Telecoms Mergers Will Boost Capex, Driving Prices Lower and Speeds Higher." https://www.orange.com/fr/content/download/33263/1086075/version/2/file/Supersonic+13.04.15.pdf.

Jeanjean, François and Georges Vivien Houngbonon (2015). "Optimal Number of Firms in the Wireless Markets." 26th European Regional Conference of the International Telecommunications Society (ITS), Madrid, Spain, 24-27 June 2015, International Telecommunications Society (ITS), Madrid. https://www.econstor.eu/bitstream/10419/127153/1/Jeanjean-Houngbonon.pdf.

Jeanjean, François and Georges Vivien Houngbonon (2017). "Market structure and investment in the mobile industry." *Information Economics and Policy*, vol. 38, issue C, 12-22.

Ofcom (2016). "A Cross-Country Econometric Analysis of the Effect of Disruptive Firms on Mobile Pricing." https://www.ofcom.org.uk/__data/assets/pdf_file/0019/74107/research_document.pdf.

Pedrós, Xavier, Kalvin Bahia, Pau Castells, and Serafino Abate (2017). "Assessing the Impact of Mobile Consolidation on Innovation and Quality: An Evaluation of the Hutchison/Orange merger in Austria." GMSA. https://www.gsma.com/publicpolicy/wp-content/uploads/2017/07/GSMA_Assessing-the-impact-of-mobile-consolidation-on-innovation-and-quality_36pp_WEB.pdf. Cited as GMSA (2017).

RTR-GmbH (2016). "Ex-Post Analysis of the Merger Between H3G Austria and Orange Austria." https://www.rtr.at/en/inf/Analysis_merger_H3G_Orange/Ex_post_analysis_merger_H3G_Orange_RTR.pdf. Cited as RTR (2016).

Woroch, Glenn A. (2019), Spectrum Concentration and Performance of the U.S. Wireless Industry, *Review of Industrial Organization*, https://doi.org/10.1007/s11151-019-09695-5. Cited as Woroch (2019).

A Review of the Empirical Evidence on the Effects of Market Concentration and Mergers in the Wireless Telecommunications Industry

Eric Fruits, Justin (Gus) Hurwitz, Geoffrey A. Manne, Julian Morris, and Alec Stapp

Appendix A

Review of Economic Analyses of 4-to-3 and Comparable Mergers in the Wireless Telecommunications Market

Summary Table

		Price	Investment/Quality
No specific merger			
	Affeldt & Nitsche (2014)	n.s.	
	Houngbonon & Jeanjean (2014)		∩-shaped
	Jeanjean & Houngbonon (2015)		∩-shaped
	Csorba & Pápai (2015)	n.s.	
	Frontier (2015)	n.s.	n.s.
	HSBC (2015)		∩-shaped/Increase
	WIK (2015)		n.s.
	Ofcom (2016)	Increase	
	Jeanjean & Houngbonon (2015)		Increase
Austria	**T-Mobile/tele.ring**		
5-to-4 merger (2006)	Aguzzoni, et al. (2015, 2018)	n.s. / Decrease	
Netherlands	**T-Mobile/Orange**		
4-to-3 merger (2007)	Genakos, et al. (2018)	Increase	Increase
	Aguzzoni, et al. (2015, 2018)	n.s. / Increase	
Austria	**Hutchison/Orange**		
4-to-3 merger (2012)	Genakos, et al. (2018)	Increase	Increase
	Houngbonon (2015)	Decrease	
	HSBC (2015)	Decrease	
	RTR (2016)	n.s. / Increase	
	BWB (2016)	Increase	
	GSMA (2017)		Increase
	BEREC (2018)	n.s. / Increase	
UK	**T-Mobile/Orange**		
5-to-4 merger (2010)	Genakos, et al. (2018)	Increase	Increase
	Lear, et al. (2017)	Decrease	n.s. / Increase
Ireland	**Hutchison/Telefónica**		
4-to-3 merger (2014)	BEREC (2018)	Increase (short-run)	
Germany	**Telefónica/KPN**		
4-to-3 merger (2014)	BEREC (2018)	Increase (short-run)	

"n.s." denotes not statistically significant

Empirical research in wireless telecommunications industry competition is fractured in many ways that may not be helpful in guiding merger reviews by competition and telecom authorities. Many studies focus on short-run price effects and do not evaluated the extent to which post-merger entry, especially by MVNOs, tends to ameliorate or reverse price increases. In economics, the long-run is defined as the time it takes for entry or exit of firms to occur. Thus, any study that does not span a period of time sufficient to include actual or potential entry is, by definition, a study solely of short-term effects.

For example, six of the studies in this literature review analyzed the price effects of the 2012 Hutchison/Orange merger in Austria. Only one, BEREC (2018), spanned a time period that included MVNO entry three years later.

The empirical literature evaluating the effects of competition on investment is sparse: Only six of the studies in this literature review evaluate investment. And most of the studies that evaluate investment review it separately from price—either ignoring price or performing separate regressions for price effects and investment effects.

Frontier (2015) points to an interaction between investment, quality, and price:

> In the mobile sector, investment is likely to be the main driver of consumer benefits and social welfare. Investment in the mobile industry will benefit consumers in several ways:
>
> - investment will impact the quality of existing products and services which the consumers receive,
> - investment will enable innovation and the delivery of entirely new products and services, and
> - investment will lead to improved efficiencies which will lower the unit prices that consumers pay for those products and services.
>
> These are the key factors relevant for consumer welfare and each is highly dependent upon network investment in the mobile industry. Therefore, the impact of mergers on investment should be fundamental to any assessment of mobile mergers.

Frontier (2015) concludes that increased investment would be associated with improved quality and lower prices. However, if improved quality increased consumer

demand (i.e., shifts the demand curve out), consumer welfare can be increased even in the face of higher prices. Thus, a thorough merger review must consider the interaction of prices and investment/quality to evaluate whether a potential merger would enhance or harm consumer welfare. Current research does not answer this question.

I. Studies of price effects

The summary table above shows that among the studies in this literature review, statistical analysis of the effects of market concentration—measured by number of firms, HHI, or merger activity—provides mixed results. BEREC (2018) reports:

> It is clear that the evidence from the literature on the effects of 4-to-3 mergers is mixed (which is not surprising given the heterogeneity of the approaches and the events investigated). While there are studies which find significant price increases, there are also studies finding no price effects or even a decrease in prices or positive quality effects. The evidence on 5-to-4 mergers so far does not suggest that the cases investigated had negative effects for consumers. It should be noted that the only mergers that can be studied are those which have been approved by competition authorities (possibly with remedies) because they were considered not likely to impede competition significantly.

The summary table shows that most research evaluating the relationship between the number of firms or firm concentration and wireless carrier prices relies on published tariffs as a measure of price. Many of these studies, such as Aguzzoni et al. (2018), Lear et al. (2017), and Genakos et al. (2015) use a price-basket approach. They define "high," "medium," and "low" usage profiles (or "baskets") based on the consumption of voices, minutes, and data, and then identify the lowest-cost tariff or set of tariffs for each user profile and for each period and compute the average mobile expenditure. In most studies, information for only the two largest carriers is available.

The reliance of information from only the largest carriers in a country may produce biased results inasmuch as smaller carriers and MVNOs may engage in competitive pricing strategies that benefit consumers and discipline larger firms. Thus it is possible, if not likely, that nearly all studies suffer from an upward bias in their measures of price.

Affeldt & Nitsche (2014) criticize the use of tariff data in that the tariffs may be meaningless with respect to a country's consumption bundle. They also caution that researchers should be careful in tracking changes in tariffs over time and cross-country differences in demand, costs, and network quality. Lear et al. (2017), which uses the usage profile approach based on baskets defined by the OECD, concedes that the approach has several drawbacks.

None of the studies reviewed report the share of consumers represented by each of the hypothetical baskets used. Thus, even if a study reports a large, sustained price increase for a "high" basket, and small decreases for "medium" and "low" baskets, for example, it is still impossible to infer a net consumer welfare loss from the relative magnitudes of the effects because there is no way to know what fraction of the market is subject to each of them.

Perhaps more importantly for antitrust review is the implicit presumption that each usage profile represents a distinct product market. There is widespread agreement that there is considerable churn of consumers between wireless providers with often differing service offerings, and that usage patterns vary across countries and time.[1] These dynamics suggest that there is no bright line separating the wireless market into distinct product markets distinguished by usage.

Another approach uses the average revenue per user (ARPU). However, this simple measure does not distinguish between price and usage level: An increase in revenues may be attributed to indeterminate combinations of either or both increased prices and/or increased usage per user. Studies such as Affeldt & Nitsche (2014) use ARPU while accounting for usage, a measure they call "effective price per minute" (EPPM), but this measure is related only to voice services.

Finally, and as discussed in more detail below, every study suffers from one of more of the following complications:

- Failure to account for differences in pre- and post-paid plans.
- Exclusion of business plans.
- Exclusion of data-only plans.
- Computation of prices without handset subsidies.
- Failure to account for MVNO entry and/or MVNO pricing.

1

- Failure to consider competition from smaller MNOs.

A. Studies of no specific merger

Using data from 23 European countries spanning 2003 through 2012, Affeldt & Nitsche (2014) find "no positive relationship between concentration and prices and some indications that the relationship may be negative." Number of firms is their measure of competition and they confine their analysis to observations with either three or four MNOs.

In their regression with number of firms as the only independent variable, Affeldt & Nitsche (2014) find that countries with three firms have statistically significantly higher prices than countries with four firms, using effective price per minute (EPPM) as the measure of price. The regression has a relatively poor goodness-of-fit (R-squared of 0.01). The addition of a linear time trend increases the goodness-of-fit (R-squared of 0.66), but causes the number of firms variable to be insignificant and to switch signs.

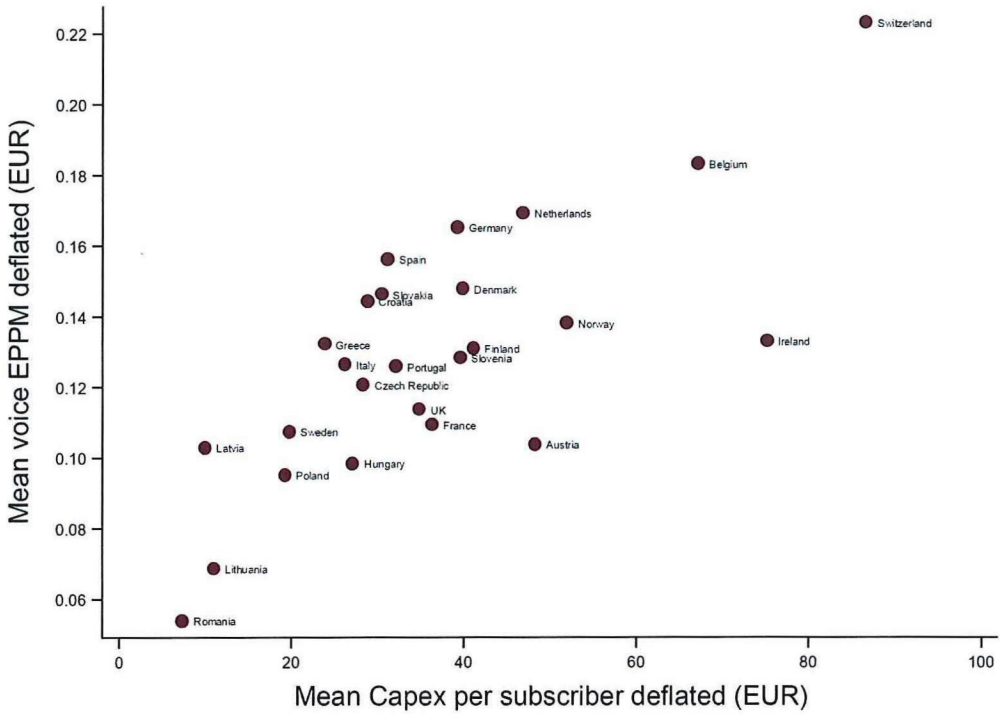
Affeldt & Nitsche (2014) is one of the few studies that includes investment, measured by capex, as an independent variable in its price regressions. In the two specifications that include capex, the paper finds higher capex is associated with higher prices, as shown in Figure 3 from their paper, below. They note that capex "is not purely an indicator of quality but also partly an indicator of differences in costs (at given quality levels)."

Affeldt & Nitsche (2014) criticize the use of tariff data, which is used by most of the research in this area. They argue that hypothetical baskets may be "relatively meaningless" in a particular country, the choice of basket may drive results, and the choice of basket does not allow for changes in consumer usage over time.

Using data from 27 European countries for 2003 through 2010, Csorba & Pápai (2015) find a wide range of effects of the number of firms on prices. These effects vary with how firm activity is measured: e.g., number of MNOs, whether the change in number of firms was associated with entry or a merger, whether an entering firm was a multinational firm or a "disruptive" firm. Csorba & Pápai (2015) conclude there are no price-increasing effects of 5-to-4 mergers. For the only 4-to-3 merger in their data (the 2004 acquisition of Orange by TeliaSonera in Denmark), they find no

significant price effects in the first two years, but a 29 percent increase in prices in the third year after the merger.

Figure 3: Voice EPPM over Capex per subscriber (averaged over the period 2003 to 2012)



Frontier (2015) finds no statistically significant relationship between prices and concentration (measured by HHI) or number of firms (measured by a dummy variable). The report uses data from the EU for the years 2000 through 2014. It measures competition by HHI and a dummy for four firms (versus three firms) as measures of competition. Average revenue per minute of use is the measure of price and capex the measure of investment.

WIK (2015), criticizing Frontier's (2015) use of ARPM as a measure of prices, notes that the measure may not be appropriate if the mix of call-types or volumes differs between countries. Nevertheless, WIK (2015) concurs with Frontier's (2015) assessment that competition authorities that focus on short-term price effects overlook longer term "dynamic efficiencies" arising from mergers.

A. Studies of specific mergers

1. Austria: T-Mobile/tele.ring

Using a difference-in-difference approach Aguzzoni et al. (2018) conclude that after the acquisition—for which remedies were imposed—**prices in Austria did not increase relative to the considered control countries**. Their regression results, presented below, indicate the merger likely led to lower prices in the short- and medium-term across each of the hypothetical consumption baskets.

Table 5 Estimation of merger effect Austria—four cheapest tariffs

Dep. variable basket	(1) Log price Low	(2) Log price Low	(3) Log price Mid	(4) Log price Mid	(5) Log price High	(6) Log price High
Short-term effect	−0.231***	−0.019	−0.134***	−0.056	−0.074	−0.104*
	(0.036)	(0.055)	(0.042)	(0.058)	(0.045)	(0.058)
Medium-term effect	−0.340***	0.005	−0.180**	−0.057	−0.128	−0.177*
	(0.052)	(0.096)	(0.071)	(0.102)	(0.074)	(0.095)
GDP growth	1.562	1.351	0.906	1.282	1.114	1.433
	(1.296)	(1.107)	(1.500)	(1.203)	(1.482)	(1.308)
Log MTR	0.007	0.128	0.098	0.120	0.130	0.125
	(0.135)	(0.118)	(0.167)	(0.084)	(0.172)	(0.081)
Observations	1727	1727	1727	1727	1727	1727
R^2	0.737	0.754	0.815	0.841	0.832	0.865
Country-spec. trend	No	Yes	No	Yes	No	Yes
Common trend test (p val)	0.014	–	0.261	–	0.674	–

Cluster-robust SE below coefficients (SE clustered at country level)
Time fixed effects and country-MNO fixed-effects
Period: Q2/2004–Q2/2008; 8 quarters pre- and 8 quarters post-merger; Q2/2006 is dropped (merger quarter)
Common trend test—null hypothesis of common trend
Significance level: ***1, **5, *10%

Using a synthetic control group approach Aguzzoni et al. (2015) find a **price reduction for Austria following the merger, relative to the selected control countries**:

> For the Low basket we estimate a strong price reduction of 20% in the short term and 40% in the medium term. For the Mid basket we estimate a price drop of 8% and 15% over the same periods, and for the High basket we find negligible effects.

2. *Netherlands: T-Mobile/Orange*

Using a difference-in-difference approach Aguzzoni et al. (2018) conclude that after the acquisition **prices increased in the Netherlands in the analyzed period, relative to the control countries.** They caution that they **could not establish whether price increases were exclusively caused by the T-Mobile/Orange merger or in part by possible price effects brought about by the KPN/Telfort merger completed two years earlier** in the Netherlands. The regression results, presented below, indicate a mix of non-significant and statistically significant estimated coefficients, with the size and significance determined by the inclusion of a country-specific linear time trend in the regression.

Table 6 Estimation of merger effect the Netherlands—four cheapest tariffs

Dep. variable basket	(1) Log price Low	(2) Log price Low	(3) Log price Mid	(4) Log price Mid	(5) Log price High	(6) Log price High
Short-term effect	0.062	0.148**	0.093**	0.126**	0.133***	0.050
	(0.049)	(0.052)	(0.035)	(0.053)	(0.021)	(0.036)
Medium-term effect	0.009	0.141*	0.099**	0.149	0.167***	0.030
	(0.050)	(0.070)	(0.042)	(0.084)	(0.036)	(0.063)
GDP growth	2.598**	1.315**	1.964**	0.980*	1.825**	0.806*
	(0.889)	(0.581)	(0.765)	(0.456)	(0.644)	(0.384)
Log MTR	0.015	−0.032	−0.032	−0.036	−0.083	−0.029
	(0.126)	(0.065)	(0.088)	(0.037)	(0.065)	(0.059)
Observations	1318	1318	1318	1318	1318	1318
R^2	0.707	0.727	0.785	0.806	0.825	0.842
Country-spec. trend	No	Yes	No	Yes	No	Yes
Common trend test (p val)	0.039	–	0.410	–	0.005	–

Cluster-robust SE below coefficients (SE clustered at country level)
Time fixed effects and country-MNO fixed-effects
Period: Q2/2005–Q3/2009; 4 quarters pre- and 8 quarters post-merger; Q2-Q3/2007 excluded quarters (merger quarters)
Common trend test—null hypothesis of common trend
Significance level: ***1, **5, *10%

Using a synthetic control group approach Aguzzoni et al. (2015) find **price increases for Austria following the merger, relative to the selected control countries, but "none of the estimated effects appears to be significant."**

Genakos, et al. (2018) do not directly estimate the effect of the merger on prices in the Netherlands. They use data from 33 European countries for the years 2002-14, with the number of firms, HHI, and entry/exit of firms as independent variables measuring competition, and apply the estimates from the HHI regressions to estimate the effect of mergers in Austria, the Netherlands, and the United Kingdom.

Using the number of firms as independent variable, the estimates of Genakos, et al. (2018) suggest, in separate regressions:

- The addition of a fourth competitor (new entry) would be associated with a price reduction of 8.6 percent;
- The loss of a fourth competitor (e.g., a four to three merger) would be associated a price increase of 15.9 percent; and
- Cumulative net exit of a competitor would be associated with a price increase of 4.3 percent.

Genakos et al. (2018) express HHI as a percent, rather than the standard 0-10,000 scale. Using HHI as independent variable, they suggest a 10 percentage point increase in HHI would be associated with a 20-25 percent increase in price. They estimate that **the T-Mobile/Orange merger increased HHI by 3.6 percentage points, suggesting a 0.6 to 6.8 percent increase in prices.**

Genakos et al. (2018) caution that the T-Mobile/Orange merger may not be the only, or most important, factor explaining the price differences, and identify the earlier KPN/Telfort merger as one additional factor.

3. *Austria: Hutchison/Orange*

BEREC (2018) describes the Hutchison/Orange merger in Austria as "the most investigated mobile merger in terms of ex-post analysis." Genakos, et al. (2018), Houngbonon (2015), HSBC (2015), RTR (2016), BWB (2016), and BEREC (2018) analyze the effects of the merger on prices, with a **wide range of estimated effects, ranging from a 40 percent decrease in price (Aguzzoni, et al., 2015) to 90 percent increase in price (RTR, 2016).**

BEREC (2018) is the most recent study of the Hutchison/Orange merger in Austria. The authors use data from 13 European countries spanning 2012-16, and covering two years prior to the merger and three years post-merger. The data do not include MVNO prices, handset subsidies, and business plans and data-only plans. The report

concludes there is **evidence that the merger led to significant price increases in the first two years.** However, **after two years—with MVNO entry—the effect became considerably smaller and statistically insignificant** in most of BEREC's specifications, as shown in Table 3 from the report, shown below.

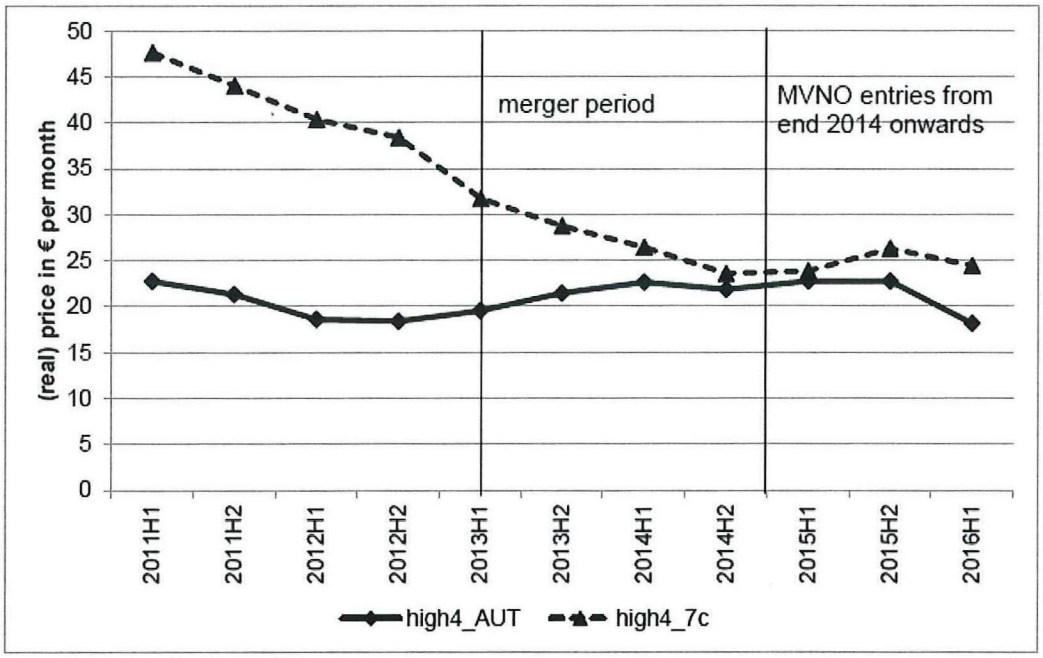
Table 3: Results for Austria, country-level, 2013 usage

	Low (4 tariffs)			Medium (4 tariffs)			High (4 Tariffs)		
	DiD basic	DiD trend	Synth	DiD basic	DiD trend	Synth	DiD basic	DiD trend	Synth
2013 H2	0.179	0.244**	0.098	0.254	0.372***	0.246	0.423***	0.477***	0.187
	(0.162)	(0.023)	(0.571)	(0.132)	(0.007)	(0.143)	(0.003)	(0.002)	(0.286)
2014 H1	0.261***	0.223*	0.280†	0.418***	0.483***	0.449	0.520***	0.532***	0.298
	(0.004)	(0.070)	(0.000)	(0.000)	(0.000)	(0.143)	(0.000)	(0.000)	(0.429)
2014 H2	0.328***	0.258**	0.247†	0.518***	0.545***	0.456†	0.661***	0.664***	0.452
	(0.000)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.286)
2015 H1	0.248***	0.178	0.153†	0.493***	0.561***	0.617†	0.662***	0.671***	0.474
	(0.002)	(0.186)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.286)
2015 H2	0.277***	0.168	0.138†	0.549***	0.564***	0.533†	0.666***	0.663***	0.463
	(0.007)	(0.300)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.143)
2016 H1	0.100	-0.004	-0.038	0.230*	0.301*	0.117	0.381***	0.387*	0.142
	(0.379)	(0.982)	(0.714)	(0.067)	(0.076)	(0.429)	(0.000)	(0.063)	(0.429)
GDP growth	0.621	-0.321		4.614	2.114		4.141	3.690	
	(0.830)	(0.848)		(0.132)	(0.411)		(0.107)	(0.219)	
MTRs	-0.114	-0.232*		0.097	-0.020		0.034	-0.022	
	(0.287)	(0.088)		(0.444)	(0.898)		(0.763)	(0.901)	
constant	2.443***	7.596***		2.660***	10.813***		2.497***	5.910**	
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.012)	
Obs.	80	80		80	80		80	80	
R^2	0.845	0.927		0.813	0.922		0.906	0.943	
Trend test passed?	Yes			Yes			Yes		

Country and time fixed effects included in the regressions (but not shown in the table)

DiD: Robust p-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Synth: Standardised p-values (Galiani and Quistorff, 2016): † treated county has highest RMSP-ratio

Figure 6 from BEREC (2018), shown below, indicates **much of the price difference between Austria and comparison countries results from a decline in comparison country prices, rather than increases in prices in Austria. After MVNO entry, the figure shows that prices in Austria declined, while prices in comparison countries increased.**



7c refers to an average of the seven control group countries BE, DK, ES, EL, IT, PT, SE

Figure 6: Price trends for users with a high usage profile in Austria

BEREC (2018) cautions that they may overestimate the impacts of the merger on price because of "significant competitive pressure" from the entry of additional MVNOs in 2015. The study points out that, in addition to the merger, another transaction Hutchison spun off the Orange sub-brand Yesss! to A1 Telekom Austria, creating a "more symmetrical market structure."

Genakos, et al. (2018) do not directly estimate effects of the merger on prices in Austria. They use data from 33 European countries for the years 2002-14, with the number of firms, HHI, and entry/exit of firms as independent variables measuring competition. They apply the estimates from the HHI regressions to estimate the effect of mergers in Austria, the Netherlands, and the United Kingdom.

Using the number of firms as independent variable, the estimates of Genakos, et al. (2018) suggest, in separate regressions:

- The addition of a fourth competitor (new entry) would be associated with a price reduction of 8.6 percent;

- The loss of a fourth competitor (e.g., a four to three merger) would be associated a price increase of 15.9 percent; and
- Cumulative net exit of a competitor would be associated with a price increase of 4.3 percent.

Genakos et al. (2018) express HHI as a percent, rather than the standard 0-10,000 scale. Using HHI as independent variable, they suggest a 10 percentage point increase in HHI would be associated with a 20-25 percent increase in price. They **estimate that the Hutchison/Orange merger increased HHI by 6.4 percentage points, suggesting a 1.0 to 12.2 percent increase in prices**.

The time period covered by Genakos et al. (2018) does not include MVNO entry. BEREC (2018) notes that two years after the merger, with MVNO entry, their effect became considerably smaller and statistically insignificant in most specifications.

The Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR, 2016) **estimates price increases of 24 percent in the short run and 90 percent in the long run in the smartphone segment**. The study **estimates no significant change in the short run and 31 percent increase in the long run in the traditional segment**. RTR (2016) uses data from 11 European countries spanning 2011-14 and a merger dummy as measure of competition.

Figure 2 from RTR (2016), shown below, indicates **much of the price difference between Austria and comparison countries in the smartphone segment results from a decline in comparison country prices, rather than increases in prices in Austria**—a finding similar to that shown in BEREC (2018). The time period covered by RTR (2016) does not include MVNO entry, which occurred in 2015. BEREC (2018) notes that two years after the merger, with MVNO entry, their effect became considerably smaller and statistically insignificant in most specifications.

The Austrian Federal Competition Authority (BWB) 2016 uses a merger simulation to **estimate price increases of 14-20 percent after merger**. BWB (2016) makes clear that it consider the Hutchison/Orange merger together with sale of the Orange Yesss! segment to Telecom Austria. Thus, BWB (2016) does not evaluate the Hutchison/Orange merger by itself.

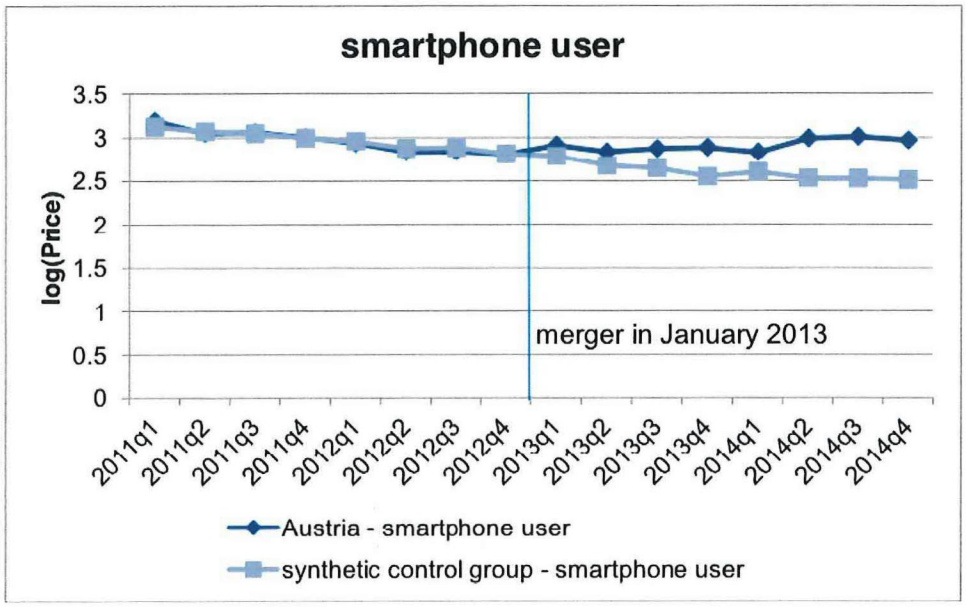


Figure 2: Price development in Austria compared to the synthetic control group

BWB (2016) notes its analysis does not include MVNO entry, which occurred in 2015, and was associated with a decrease in price.

Houngbonon (2015) examines the Hutchison/Orange four to three merger in Austria and a three to four entry in France. **He estimates the effect of the Austria merger as a price decrease. The paper reports no effect of the merger on standalone data and a decrease of $6 per GB in price for bundled data.** Results indicate a price-increasing effect associated with the entry of a fourth MNO in France.

The study uses data from 40 countries for seven quarters spanning 2013-14 to identify countries with the most similar pre-merger price series to Austria and identifies Italy as the most similar country. Estimates are based the comparison of Austria and Italy's price series pre- and post-merger, using a merger dummy. HSBC's (2015) price analysis follows Houngbonon's (2015) approach and supports the latter's results.

HSBC (2015) estimates the effects of competition on prices and investment. For the price analysis, the research examines the Hutchison/Orange four to three merger in Austria and a three to four entry in France. As with Houngbonon (2015), **the paper finds no price effect of the merger on standalone data and a decrease of $8.00 to**

$8.60 per GB in price for bundled data. Results indicate a price-increasing effect associated with the entry of a fourth MNO in France.

For the price analysis, HSBC (2015) focuses on the same issue as Houngbonon (2015), and applies the same econometric approach to a slightly different database.

4. UK: T-Mobile/Orange

Genakos, et al. (2018) do not directly estimate effects of the merger on prices in the U.K.. They use data from 33 European countries for the years 2002-14, with the number of firms, HHI, and entry/exit of firms as independent variables measuring competition. They apply the estimates from the HHI regressions to estimate the effect of mergers in Austria, the Netherlands, and the United Kingdom.

Using the number of firms as independent variable, the estimates of Genakos, et al. (2018) suggest, in separate regressions:

- The addition of a fourth competitor (new entry) would be associated with a price reduction of 8.6 percent;
- The loss of a fourth competitor (e.g., a four to three merger) would be associated a price increase of 15.9 percent; and
- Cumulative net exit of a competitor would be associated with a price increase of 4.3 percent.

Genakos et al. (2018) express HHI as a percent, rather than the standard 0-10,000 scale. Using HHI as independent variable, they suggest a 10 percentage point increase in HHI would be associated with a 20-25 percent increase in price. **They estimate that the T-Mobile/Orange merger increased HHI by 6.7 percentage points, suggesting a 1.1 to 12.7 percent increase in prices.**

Lear, et al. (2017) examine a five to four merger in 2010 in the U.K. between T-Mobile and Orange. The econometric analysis, using a difference-in-difference approach similar to Aguzzoni et al. (2018) **indicates that the prices of mobile services fell 8.5-18.6 percent because of the merger, in particular for medium-consumption and high-consumption profiles, with no significant effect on low-consumption profiles**. The study uses data from 13 European countries spanning 2009-14.

Lear, et al. (2017) report T-Mobile and Orange, whose aggregate market share by subscribers was 35.6 percent before the merger, dropped to 29.2 percent four years

after the merger. Over the same period, the aggregate market shares of MVNOs increased from 11.3 percent to 13.6 percent.

5. *Ireland: Hutchison/Telefónica*

BEREC (2018) uses data from 13 European countries spanning 2012-16, and covering two years prior to the merger and 18 months post-merger. The data do not include MVNO prices, handset subsidies, and business plans and data-only plans. BEREC (2018) estimates some evidence of price increases for all three baskets in the difference-in-difference specification. However, the results are not robust across the difference-in-difference specifications and the synthetic control group specifications.

Table 5: Results for Ireland, country-level, 2013 usage

	Low (4 tariffs)			Medium (4 tariffs)			High (4 tariffs)		
	DiD basic	DiD trend	**Synth**	**DiD basic**	DiD trend	**Synth**	**DiD basic**	DiD trend	**Synth**
2015 H1	0.163** (0.042)	0.351*** (0.000)	0.244 (0.400)	0.398*** (0.000)	0.402** (0.011)	0.444 (0.300)	0.436*** (0.000)	0.279* (0.063)	0.829 (0.300)
2015 H2	0.121 (0.167)	0.414*** (0.002)	0.229 (0.400)	0.156 (0.136)	0.235 (0.312)	0.239 (0.400)	0.360*** (0.002)	0.154 (0.439)	0.682 (0.500)
2016 H1	0.052 (0.664)	0.329*** (0.009)	0.197 (0.400)	0.370*** (0.004)	0.346 (0.107)	0.167 (0.900)	0.305** (0.027)	0.063 (0.774)	0.644 (0.500)
GDP growth	0.256 (0.798)	-0.358 (0.731)		1.078 (0.312)	0.198 (0.866)		-0.420 (0.752)	-0.353 (0.766)	
MTRs	-0.118 (0.131)	-0.063 (0.440)		-0.058 (0.484)	-0.065 (0.440)		0.041 (0.623)	0.005 (0.956)	
constant	2.394*** (0.000)	6.723*** (0.000)		2.675*** (0.000)	9.131*** (0.002)		3.036*** (0.000)	6.112*** (0.000)	
Obs.	88	88		88	88		88	88	
R^2	0.873	0.926		0.877	0.915		0.903	0.931	
Trend test passed?	Yes			Yes			Yes		

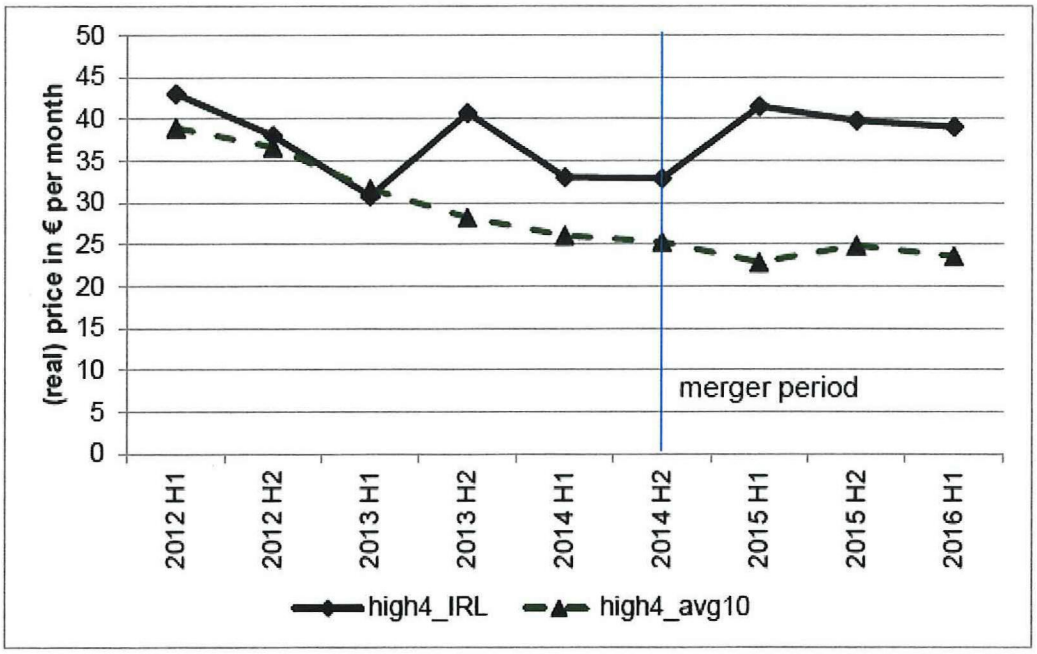
Country and time fixed effects included in the regressions (but not shown in the table)

DiD: Robust p-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Synth: Standardised p-values (Galiani and Quistorff, 2016): † treated county has highest RMSP-ratio

For example, as shown below in Table 5 from BEREC (2018), while the difference-in-difference approach **finds statistically significant short term price increase in each basket, the synthetic control group approach finds no statistically significant price increase for any basket over any period of time.**

Figure 9 from BEREC (2018), shown below, indicates **much of the price difference between Ireland and comparison countries for the high basket results from a decline in comparison country prices, rather than increases in prices in Ireland.**



avg10 refers to a simple average of the ten control group countries

Figure 9: Price trends for users with a high usage profile in Ireland

6. *Germany: Telefónica/KPN*

BEREC (2018) uses data from 13 European countries spanning 2012-16, and covering two years prior to the merger and 18 months post-merger. The data do not include MVNO prices, handset subsidies, and business plans and data-only plans. BEREC (2018) estimates statistically significant price increases for all three baskets in the difference-in-difference specification. However, the results are not robust across the difference-in-difference specifications and the synthetic control group specifications.

For example, as shown below in Table 8 from BEREC (2018), while the difference-in-difference approach finds **statistically significant price increases in each basket, with the exception of the low basket in the first half of 2016, the synthetic control group approach only finds no statistically significant price increase for any basket over any period of time.**

Table 8: Results for Germany, 4 cheapest tariffs, country-level, 2013 usage

	Low (4 tariffs)			Medium (4 tariffs)			High (4 tariffs)		
	DiD basic	DiD trend	Synth	DiD basic	DiD trend	Synth	DiD basic	DiD trend	Synth
2015 H1	0.434***	0.458***	0.461	0.202***	0.270*	0.088	0.136**	0.180	0.154
	(0.000)	(0.000)	0.100	(0.004)	(0.083)	0.200	(0.039)	(0.304)	0.400
2015 H2	0.248***	0.277**	0.212	0.139*	0.219	0.043	0.131*	0.181	0.181
	(0.000)	(0.034)	0.300	(0.050)	(0.249)	0.200	(0.071)	(0.402)	0.100
2016 H1	0.454***	0.506***	0.431†	0.348***	0.470**	0.126	0.250***	0.327	0.124
	(0.000)	(0.002)	0.000	(0.000)	(0.048)	0.200	(0.001)	(0.219)	0.400
GDP growth	1.017	-0.000		2.484*	0.480		2.762**	1.362	
	(0.483)	(1.000)		(0.097)	(0.800)		(0.047)	(0.461)	
MTRs	-0.094	-0.002		-0.064	-0.022		0.041	0.062	
	(0.274)	(0.975)		(0.472)	(0.820)		(0.662)	(0.576)	
constant	2.375***	4.555***		2.647***	6.071*		3.022***	4.686*	
	(0.000)	(0.006)		(0.000)	(0.086)		(0.000)	(0.055)	
Obs.	77	77		77	77		77	77	
R^2	0.863	0.922		0.877	0.913		0.899	0.919	
Trend test passed?	Yes			Yes			Yes		

Country and time fixed effects included in the regressions (but not shown in the table)

DiD: Robust p-values in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Synth: Standardised p-values (Galiani and Quistorff, 2016): † treated county has highest RMSP-ratio

In the case of the low basket, it should also be noted that no data is available for the MVNO and service provider segment or for sub-brands of MNOs. The paper points out this may be especially relevant in Germany as the MVNO and service provider segment of the German market is relatively large at approximately 20 percent of the market.

II. Investment and quality effects

B. Studies of no specific merger

Using data from 199 countries around the world for 2000 through 2014, Houngbonon & Jeanjean (2014) find an inverted-U relationship between the intensity of competition (measured by a Lerner index) and investment (measured by capex). **The capex maximizing Lerner index is at 63 percent plus or minus 6 percentage points at the 5 percent confidence level, which corresponds to an EBITDA of 37 percent of total revenue.**

Using an approach similar to Houngbonon & Jeanjean (2014), HSBC (2015) uses capex data from 66 countries for 2003-13 to evaluate the four to three Hutchison/Orange merger in Austria, using a Lerner index as a measure of competition, where L = 1 - (EBITDA/Revenue). The report estimates the **maximum level of investment, as measured by capex, occurs at an EBITDA of 38 percent.** HSBC (2015) reports the average EBITDA of the mobile sector in Europe is significantly below this—on average 31-32 percent. Thus, **the report concludes a four to three merger in Europe would result in EBITDA closer to the optimal amount of 38 percent and would, therefore, lead to higher investment with better outcomes for users.**

Both Frontier (2015) and WIK (2015) find no statistically significant relationships of competition measured by HHI or a four firm (versus three firm) dummy.

Jeanjean & Houngbonon (2015) construct a dataset 38 countries worldwide, spanning the years 2004 to 2013. The data do not include Canada, the U.S., India, and China. They estimate capex at both the firm level (818 observations) and the market level (378 observations). Rather than use the number of firms in a country as a measure of competition, the study uses a dummy variable for each number of firms, with three firms as the baseline. Thus, the regression results are relative to a country with three firms. In addition, the study uses a measure of relative market share as a measure of what the authors call "relative efficiency." **They conclude a merger would be associated with an increase in each firm's investment and firms with a larger market share would make larger investments. They also conclude that aggregate investment is maximized at three or four MNOs.**

Jeanjean and Houngbonon (2017) use a dataset of 50 mobile operators from 17 European countries, spanning the years 2006 through 2015. The data includes operator-level information regarding capex, market share by subscribers (both pre- and post-paid), average revenue per subscriber, EBITDA, and mobile termination rates. Country-level data include the number of mobile operators, the total number of subscribers, the penetration rate of fixed lines, population, gross domestic product (GDP) per capita, and a political variable that aims to capture the position of the government towards the welfare state. Investment is measured by the natural logarithm of capex. Competition is proxied by the number of mobile operators in each country and each firm's market share asymmetry. Market share asymmetry is measured as the difference between each firm's market share and the average market share for the country. **Jeanjean and Houngbonon (2017) find that in markets that are asymmetric (i.e., where firms are of different sizes), an increase in the number of firms tends to have a more significantly negative effect on investment by smaller firms. This suggests that a merger that results in a more symmetric market structure would be associated with a stronger positive effect on investment.**

Woroch (2019) uses a data set of 697 U.S. Cellular Market Areas, spanning the years 2012–2013. Using carrier-level data, he concludes quality and coverage measures are positively related to carrier-level holdings of spectrum as a share of total holdings in the CMA. In particular higher carrier-level holdings of spectrum are associated with statistically significant broader 4G coverage, as well as generally faster and more reliable networks (with mixed statistical significance). In addition, Woroch (2018) concludes carriers with faster and more reliable networks and with a broader deployment of 4G technology are associated with more subscribers.

C. Studies of specific mergers

Genakos, et al. (2018) do not separately estimate effects of individual mergers on investment in specific countries. They use data from 33 European countries for the years 2002-14, with the number of firms, HHI, and entry/exit of firms as independent variables measuring competition. They apply the estimates from the HHI regressions to estimate the effect of mergers in Austria, the Netherlands, and the United Kingdom.

Using the number of firms as independent variable, the estimates of Genakos, et al. (2018) suggest, in separate regressions:

- The addition of a fourth competitor (new entry) would be associated with a price reduction of 8.6 percent;
- The loss of a fourth competitor (e.g., a four to three merger) would be associated a price increase of 15.9 percent; and
- Cumulative net exit of a competitor would be associated with a price increase of 4.3 percent.

Genakos et al. (2018) express HHI as a percent, rather than the standard 0-10,000 scale. Using HHI as independent variable, **they suggest a 10 percentage point increase in HHI would be associated with a 24-28 percent increase in price**. For their three mergers evaluated in their report, they estimate:

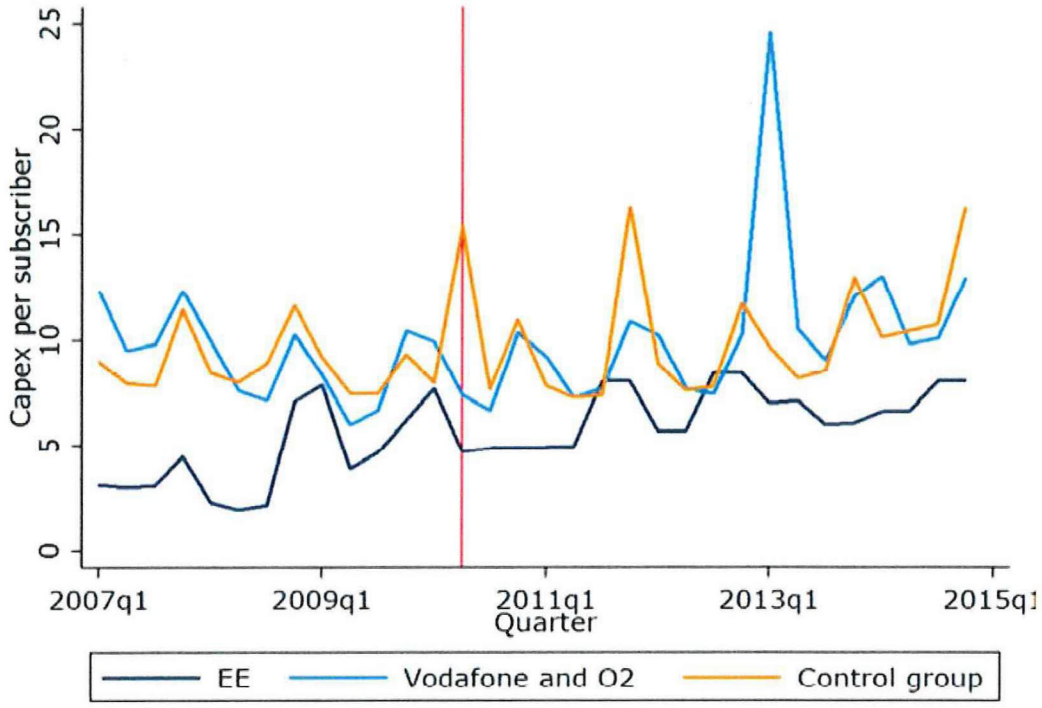
- **The Hutchison/Orange merger in Austria increased HHI by 6.4 percentage points and was estimated to result in 1.2 to 25.5 percent increase investment;**
- **The T-Mobile/Orange merger in the Netherlands increased HHI by 3.6 percentage points and was estimated to result in 0.7 to 14.3 percent increase investment**; and
- **The T-Mobile/Orange merger in the UK increased HHI by 6.7 percentage points and was estimated to result in 1.2 to 26.5 percent increase investment.**

Lear, et al. (2017) reviewed the five to four merger in 2010 in the U.K. between T-Mobile and Orange. The study uses data from 13 European countries spanning 2009-14. The study uses a merger dummy as measure of competition and uses capex and capex per subscriber as measures of investment. The econometric analysis suggests that **the merger was associated with increased investment, as measured by capex. However, estimates calculated using the ratio of capex to the number of subscribers are not significant**.

Figure 6.4 from Lear, et al. (2017) indicates relatively high seasonal variation in capex per subscriber, which could affect the estimates of statistical significance (where "EE" denotes combined T-Mobile and Orange). The authors, however, use several specification to control for seasonality and, "rule out the possibility that the volatility of the results is driven by seasonality in capex data."

GSMA (2017) analyzes the four to three Hutchison/Orange merger in Austria on innovation and quality in mobile services, using data from 17 European countries spanning 2011-16, and using a merger dummy as measure of competition. The study uses 4G coverage data in order to measure the level of innovation and download/upload speeds of 4G and 3G networks as indicators of quality of service. **The estimates suggest that the merger accelerated the rollout of Hutchison's 4G network and that all measures of network quality also increased.**

Figure 6.4 – Capex over number of subscribers, EE against other UK operators and control countries (weighted average)



BEREC (2018) criticizes the approach and data in GSMA (2017):

- No pre-merger 4G download speed data available for Hutchison.
- Limited pre-merger 4G download speed for other Austria operators. Most of the increase in speeds occurred in the two quarters immediately after the merger. BEREC concludes the timing suggests that the increases were not because of the merger.

- Pre-merger, Austria had no 800 MHz spectrum available (and 1,800 MHz spectrum was not allowed for 4G), calling into question HSBC's implication that the merger itself led to increased 4G coverage.

Studies Reviewed

Affeldt, Pauline and Rainer Nitsche (2014). "A Price Concentration Study on European Mobile Telecom Markets: Limitations and Insights." EMST Working Paper 14-07. European School of Management and Technology. https://www.esmt.org/price-concentration-study-european-mobile-telecom-markets-limitations-and-insights.

Aguzzoni, Luca, Benno Buehler, Luca Di Martile, Georg Ecker, Ron Kemp, Anton Schwarz, and Robert Stil (2015). "Ex-Post Analysis of Two Mobile Telecom Mergers: T-Mobile/tele.ring in Austria and T-Mobile/Orange in The Netherlands." European Commission, Directorate-General for Competition. http://ec.europa.eu/competition/publications/reports/kd0215836enn.pdf.

Aguzzoni, Luca, Benno Buehler, Luca Di Martile, Ron Kemp, and Anton Schwarz (2018). "Ex-post Analysis of Mobile Telecom Mergers: The Case of Austria and The Netherlands." *De Economist* 166(1):63-87. doi:doi.org/10.1007/s10645-017-9308-5.

Allen, James, Paolo Buccirossi, Tomaso Duso, Fabio Fradella, Alessia Marrazzo, Mattia Nardotto, Salvatore Nava, and Jo Seldeslachts (2017). "Economic Impact of Competition Policy Enforcement on the Functioning of Telecoms Markets in the EU." Prepared by Lear, DIW Berlin and Analysys Mason for the European Commission, Directorate-General for Competition. http://ec.europa.eu/competition/publications/reports/kd0417233enn.pdf. Cited as Lear et al. (2017).

Banerjee, Aniruddha and Christian M. Dippon (2009). "Voluntary Relationships Among Mobile Network Operators and Mobile Virtual Network Operators: An Economic Explanation." *Information Economics and Policy* 21(1): 72-84. https://www.sciencedirect.com/science/article/pii/S016762450800070X

Body of European Regulators for Electronic Communications (BEREC) (2018). "BEREC Report on Post-Merger Market Developments: Price Effects of Mobile Mergers in Austria, Ireland and Germany." BoR (18) 119. https://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/8168-berec-report-on-post-merger-market-devel_0.pdf.

Bundeswettbewerbsbehörde (BWB (2016). "The Austrian Market for Mobile Telecommunication Services to Private Customers: An Ex-post Evaluation of the Mergers H3G/Orange and TA/Yesss!" BWB/AW-393. https://www.bwb.gv.at/fileadmin/user_upload/PDFs/BWB2016-summary-Ex-post_evaluation_of_the_mobile_telecommunications_market.pdf.

Connolly, Michelle (2018). *Competition in Wireless Telecommunications: The Role of MVNOs and Cable's Entry into Wireless.* https://newtmobile.com/content/uploads/2018/09/Competition-in-Wireless-Telecommunications-Michelle-Connolly.pdf

Csorba, Gergely and Zoltán Pápai (2015). "Does One More or One Less Mobile Operator Affect Prices? A Comprehensive Ex-Post Evaluation of Entries And Mergers in European Mobile Telecommunication Markets." MT-DP – 2015/41. Hungarian Academy of Sciences, Center for Economic and Regional Studies. http://econ.core.hu/file/download/mtdp/MTDP1541.pdf.

Elixmann, Dieter, Ilsa Godlovitch, Iris Henseler-Unger, Rolf Schwab, and Ulrich Stump (2015). "Competition & Investment: An Analysis of the Drivers of Investment and Consumer Welfare in Mobile Telecommunications." Prepared by WIK-Consult, GmbH for Ofcom. https://www.ofcom.org.uk/__data/assets/pdf_file/0029/78365/competition_and_investment_mobile.pdf. Cited as WIK (2015).

Frontier Economics (2015). "Assessing the Case for In-Country Mobile Consolidation: A Report Prepared for the GSMA." https://www.gsma.com/publicpolicy/wp-content/uploads/2015/05/Assessing_the_case_for_in-country_mobile_consolidation.pdf.

Genakos, Christos, Tommaso Valletti, and Frank Verboven (2018). "Evaluating Market Consolidation in Mobile Communications." *Economic Policy* 33(93):45-100. doi: doi.org/10.1093/epolic/eix020.

Houngbonon, Georges Vivien and Francois Jeanjean (2014). "Is There a Level of Competition Intensity That Maximizes Investment in the Mobile Telecommunications Industry?" https://www.orange.com/en/content/download/29806/833600/version/2/file/SSRN_id2416780.pdf.

Houngbonon, Georges Vivien (2015). "The Impact of Entry and Merger on the Price of Mobile Telecommunications Services." Paper presented at 26th European Regional Conference of the International Telecommunications Society, Madrid, Spain, June 24-27. http://hdl.handle.net/10419/127148.

HSBC (2015). "Supersonic: European Telecoms Mergers Will Boost Capex, Driving Prices Lower and Speeds Higher." https://www.orange.com/fr/content/download/33263/1086075/version/2/file/Supersonic+13.04.15.pdf.

Jeanjean, François and Georges Vivien Houngbonon (2015). "Optimal Number of Firms in the Wireless Markets." 26th European Regional Conference of the International Telecommunications Society (ITS), Madrid, Spain, 24-27 June 2015, International Telecommunications Society (ITS), Madrid. https://www.econstor.eu/bitstream/10419/127153/1/Jeanjean-Houngbonon.pdf.

Jeanjean, François and Georges Vivien Houngbonon (2017). "Market structure and investment in the mobile industry." *Information Economics and Policy*, vol. 38, issue C, 12-22.

Ofcom (2016). "A Cross-Country Econometric Analysis of the Effect of Disruptive Firms on Mobile Pricing." https://www.ofcom.org.uk/__data/assets/pdf_file/0019/74107/research_document.pdf.

Pedrós, Xavier, Kalvin Bahia, Pau Castells, and Serafino Abate (2017). "Assessing the Impact of Mobile Consolidation on Innovation and Quality: An Evaluation of

the Hutchison/Orange merger in Austria." GMSA. https://www.gsma.com/publicpolicy/wp-content/uploads/2017/07/GSMA_Assessing-the-impact-of-mobile-consolidation-on-innovation-and-quality_36pp_WEB.pdf. Cited as GMSA (2017).

RTR-GmbH (2016). "Ex-Post Analysis of the Merger Between H3G Austria and Orange Austria." https://www.rtr.at/en/inf/Analysis_merger_H3G_Orange/Ex_post_analysis_merger_H3G_Orange_RTR.pdf. Cited as RTR (2016).

Woroch, Glenn A. (2019), Spectrum Concentration and Performance of the U.S. Wireless Industry, *Review of Industrial Organization*, https://doi.org/10.1007/s11151-019-09695-5. Cited as Woroch (2019).